WATER WORKS & SEWERAGE

GILLETTE PUBLICATION

ABP ABC

EDITOR

FEBRUARY, 1937
VOLUME 84. NO. 2

IN STERLING Colo

Sterling, the County Seat of Logan County, Colorado, is situated in the South Platte River Valley, about 140 miles northeast of Denver, and is served by both the Union Pacific and the Chicago, Burlington & Quincy Railroads. It is an intermediate terminal point with branches extending in six directions, making it an important railroad center. The location is such as to afford it a very favorable trade territory for many miles in all directions.

Sterling is substantially built and has adequate banking and educational facilities. Its industries include sugar plants, railroad shops, flour mills, grain elevators and a large creamery. The country surrounding Sterling is, for the most part, irrigated. A considerable portion of the land in Logan County is devoted to the production of sugar beets, wheat, oats, corn, rye, barley and beans. Large numbers of sheep and cattle are fattened in this county.

Sterling is furnished with pure water direct from wells. Since 1920 the city has been 100% metered. PITTSBURGH WATER METERS were purchased at that time, and according to H. M. Krull, City Clerk, they have been giving splendid service ever since.

PITTSBURGH EQUITABLE METER CO.

MERCO NORDSTROM VALVE CO.

MAIN OFFICES PITTSBURGH, PA.

NEW YORK COLUMBIA LOS ANGELES KANSAS CITY TULSA CHICAGO HOUSTON PHILADELPHIA MEMPHIS ATLANTA BUFFALO OAKLAND

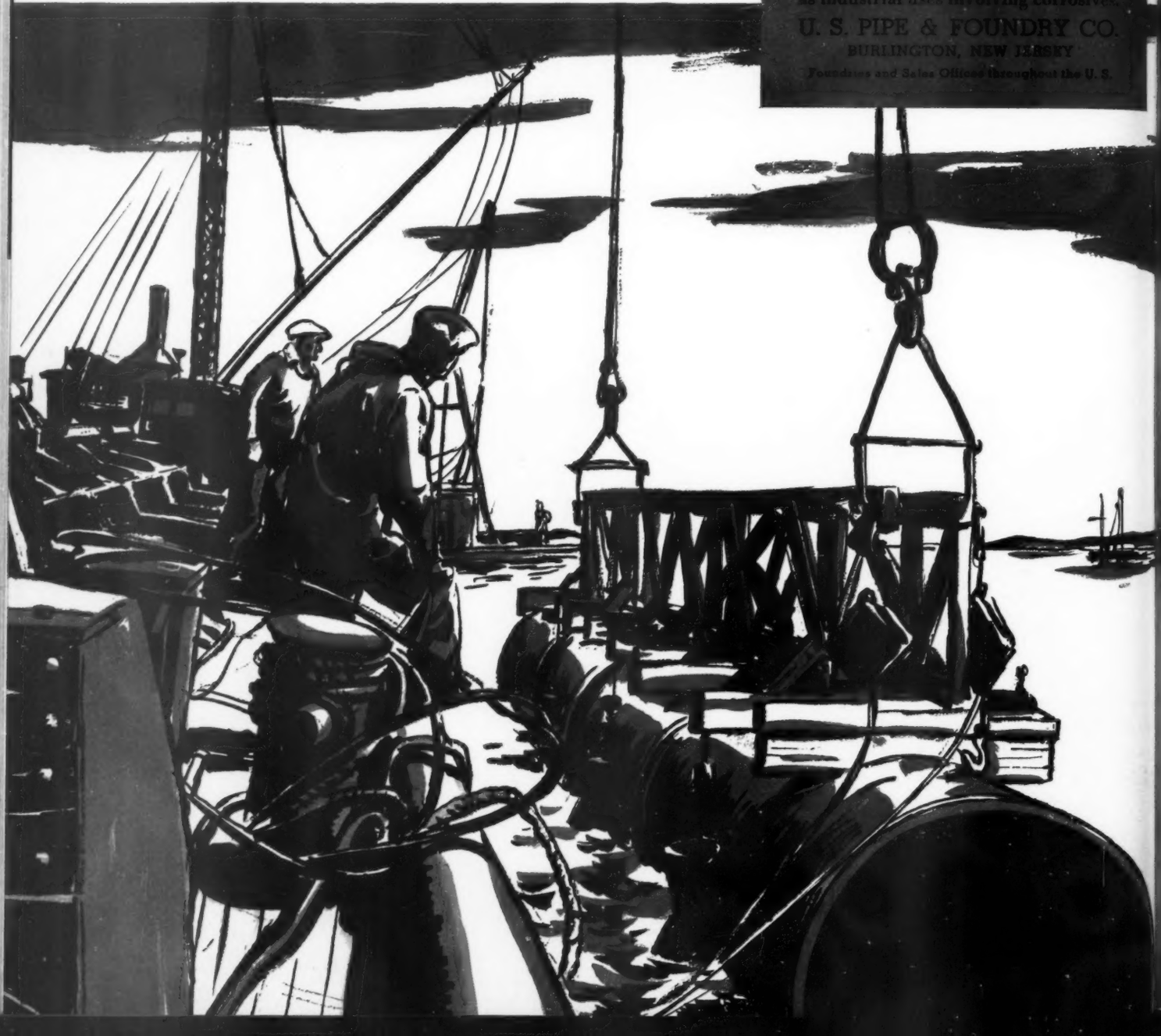
PITTSBURGH WATER METERS

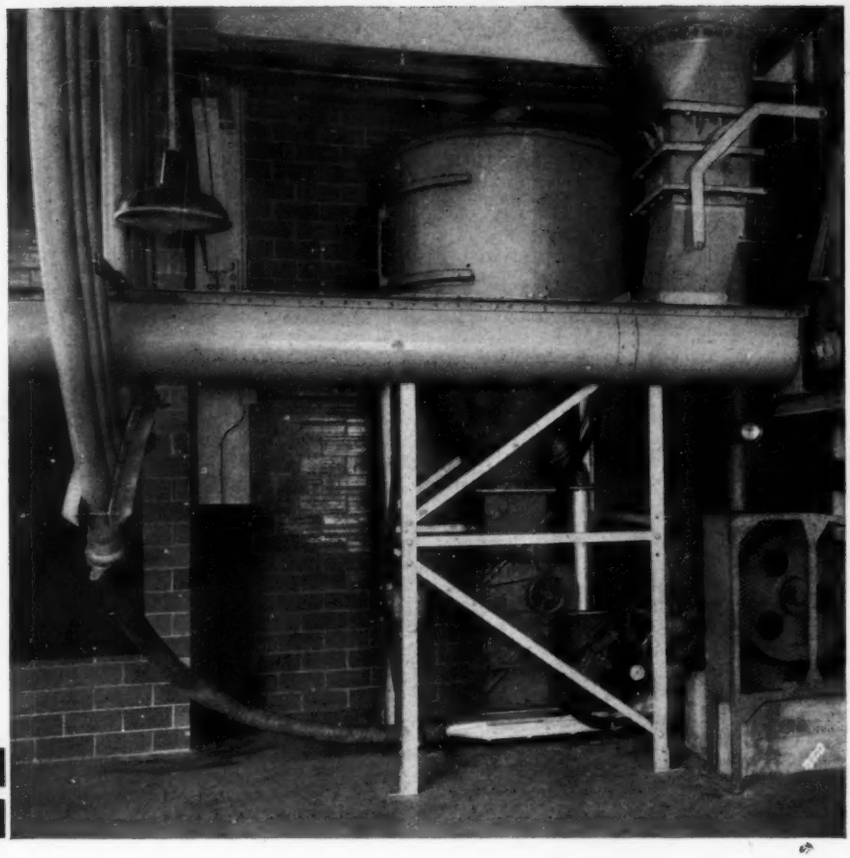
UNDER the surface—in seawater and in the ground—cast iron resists the attack of corrosive elements more effectively than any other ferrous metal practicable for the purpose, with or without linings. Special linings are in most cases unnecessary. If abnormally active waters are to be transported, we furnish U. S. pit cast pipe, or Super-de Lavaud centrifugally cast *chill-free* pipe, lined in accordance with the results of years of research and experience. Our Research Headquarters at Burlington, generally considered one of the finest foundry laboratories in the world, and our technical staffs, have made important contributions to the design and production of cast iron and alloy cast iron pipe for super-corrosive conditions.

U.S.
cast iron
PIPE

Cast iron and alloy cast iron pipe centrifugally or pit cast—for water works, gas, sewerage and drainage service as well as industrial uses involving corrosives.

U. S. PIPE & FOUNDRY CO.
BURLINGTON, NEW JERSEY
Foundries and Sales Offices throughout the U. S.





Airveyor receiver and exhauster unit installed in a mid-western water purification plant. Note the seven-way switch for conveying materials under pressure to seven storage tanks.

For small or large capacities - a few tons an hour to 150 tons an hour

Your unloading and conveying capacities need not be large to warrant the installation of the Airveyor Conveying System for fine, crushed, and granular materials. These systems are installed for requirements ranging from a few tons an hour to the largest capacities of approximately 150 tons an hour.

Large or small, in either case, it may possibly be the solution to some conveying problem you are confronted with in your plant. Our engineering department, with no obligation on your part, will be glad to make studies of your conditions and recommend equipment best suitable for your needs.

Write for bulletin—The Airveyor—for detailed information.

CONVEYING FULLER

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago: 1118 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

A-16

FULLER-KINYON, FLUXO, AND AIRVEYOR CONVEYING SYSTEMS · · · ROTARY FEEDERS AND DISCHARGE GATES
ROTARY AIR COMPRESSORS AND VACUUM PUMPS · AUTOMATIC BATCH WEIGHERS · · · BIN SIGNALS

WATER WORKS AND SEWERAGE, February, 1937, Volume 84, Number 2. Published monthly at 400 West Madison Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, $2.00 per year; Canadian and Foreign, $3.00 per year. Copyright, 1937. Entered as Second Class Matter, June 2, 1931 at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

PROTECTION···

THE average person does not fully appreciate the efforts made by the personnel of the water plants for protecting the health of the community through the furnishing of a safe water.

In making water safe, oft' times it is done at the expense of palatability.

Most everyone will judge the safety of the water by its palatability, and frequently the overdosing of chlorine to make it safe, leaves such an unpalatable taste that often the consumer dangerously resorts to the use of so-called sparkling water from the "old dug well, spring," etc.

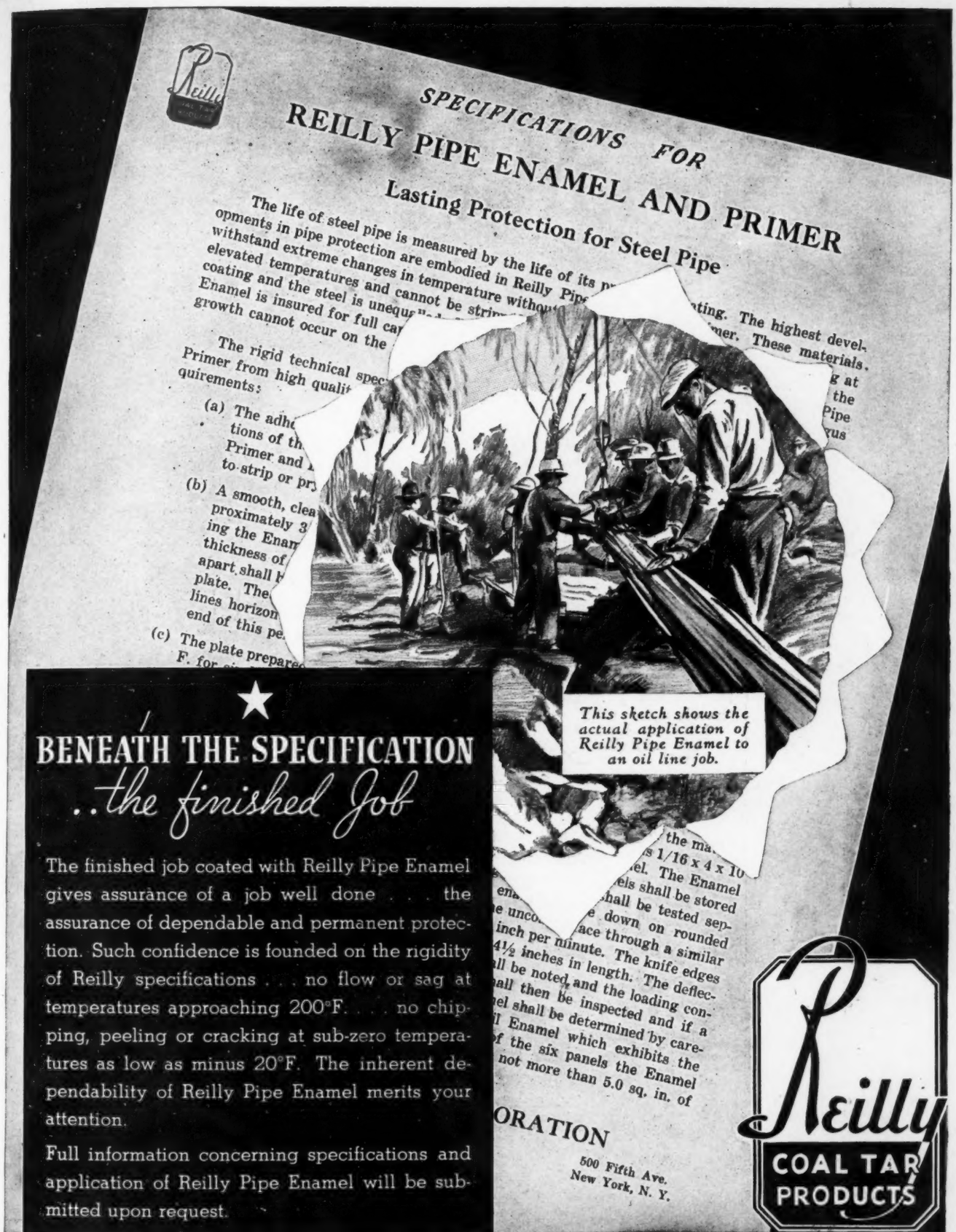
Every day there is a fuller realization of the part that AQUA NUCHAR (ACTIVATED CARBON) plays as a protective measure not only against complaints arising from tastes and odors, but indirectly against epidemics following the use of water from unauthorized sources.

A recent survey shows that the furnishing of palatable water through the use of AQUA NUCHAR averages less than 5c per person per year and it must be readily admitted that a cost such as this will fully justify its continuous use.

●

INDUSTRIAL
CHEMICAL SALES
Division
West Virginia Pulp & Paper Co.
230 Park Ave., New York
205 West Wacker Drive, Chicago, Ill.
418 Schofield Bldg., Cleveland, Ohio

"MAKE YOUR PLANS NOW TO ATTEND THE 57TH ANNUAL CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION TO BE HELD JUNE 7-11, 1937, AT THE HOTEL STATLER, BUFFALO, NEW YORK."


SPECIFICATIONS FOR
REILLY PIPE ENAMEL AND PRIMER
Lasting Protection for Steel Pipe
The life of steel pipe is measured by the life of its
opments in pipe protection are embodied in Reilly Pip
withstand extreme changes in temperature witho
elevated temperatures and cannot be strip
coating and the steel is unequ
Enamel is insured for full ca
growth cannot occur on the
The rigid technical spec
Primer from high quali
quirements:
(a) The adh
tions of th
Primer and
to strip or pr
(b) A smooth, clea
proximately 3
ing the Enam
thickness of
apart shall h
plate. The
lines horizon
end of this pe
(c) The plate prepare
F. for
ting. The highest devel-
mer. These materials.
g at
the
Pipe
us
This sketch shows the actual application of Reilly Pipe Enamel to an oil line job.
the ma
s 1/16 x 4 x 10
el. The Enamel
els shall be stored
shall be tested sep-
e down on rounded
ace through a similar
inch per minute. The knife edges
4½ inches in length. The deflec-
ll be noted, and the loading con-
all then be inspected and if a
el shall be determined by care-
l Enamel which exhibits the
f the six panels the Enamel
not more than 5.0 sq. in. of
ORATION
500 Fifth Ave.
New York, N. Y.

★

BENEATH THE SPECIFICATION
..the finished Job

The finished job coated with Reilly Pipe Enamel gives assurance of a job well done . . . the assurance of dependable and permanent protection. Such confidence is founded on the rigidity of Reilly specifications . . . no flow or sag at temperatures approaching 200°F. . . . no chipping, peeling or cracking at sub-zero temperatures as low as minus 20°F. The inherent dependability of Reilly Pipe Enamel merits your attention.

Full information concerning specifications and application of Reilly Pipe Enamel will be submitted upon request.

Reilly
COAL TAR
PRODUCTS

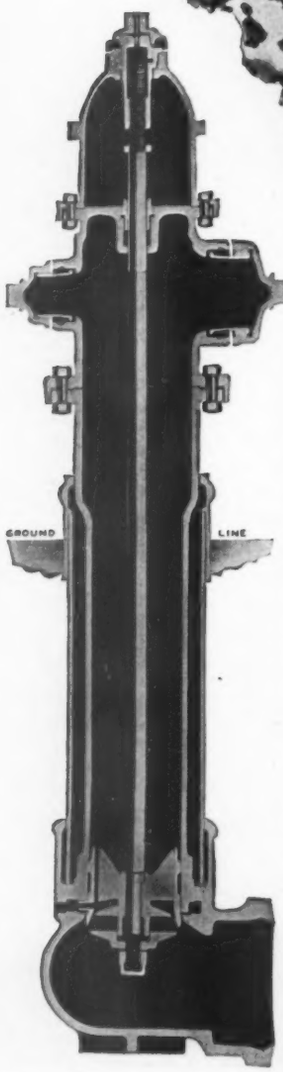
REILLY TAR & CHEMICAL CORPORATION

Executive Offices: Merchants Bank Building, Indianapolis, Indiana

2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS 500 FIFTH AVENUE, NEW YORK, N. Y. ST. LOUIS PARK, MINNEAPOLIS, MINN.

FIFTEEN PLANTS TO SERVE YOU

"FIVE-FOOT FROSTS-
Can't Heave our
MATHEWS HYDRANTS"



Has your hydrant system run into mysterious leaks, unexplained underground breaks, or undermined pavements? The chances are it's one result of having hydrants heaved upward by frost-swelled ground.

Install Mathews—the hydrants with the loose, built-in frost case. It is the one sure protection against cracked elbows, started joints, and broken hydrants. Frost grabs the Mathews protection case and lifts it, but because it is loose, no strain goes on the barrel, elbow, or main.

• • •

A loose unattached outer case extends from the elbow to the ground surface. In case of frost-upheaval it slides up freely, leaving the barrel in position. This case also allows the whole barrel to be lifted out without digging.

Last year's experience taught water works superintendents that no hydrant system is winter-safe until it is protected against frost upheaval. Remember that, and specify Mathews Hydrants. They're built for this emergency.

Mathews Hydrants

BUILT FOR EMERGENCIES

R. D. WOOD CO.

400 Chestnut St., Philadelphia, Pa.

manufacturers of SAND-SPUN PIPE which is centrifugally cast in sand molds, and R. D. Wood heavy-duty gate valves for water works.

ANOTHER CITY MAKES HORSEPOWER OUT OF SLUDGE GAS!

MADISON, WIS. — Type EN-8 vertical gas engine rated 200-230 H. P. at 450-514 r. p. m. Direct-drives blower through flexible coupling.

All that's needed to make this engine GO is "costless" sludge gas. The engine drives a blower, agitating the settling basins. Heat from the engine-exhaust is used to control the temperature of the digestion tanks.

Economy — Convenience — Reliability — these are the triple reasons why Cooper-Bessemer sludge-gas engines are entering more and more disposal plants.

Why don't YOU "check" with us, and learn what savings YOU can make?

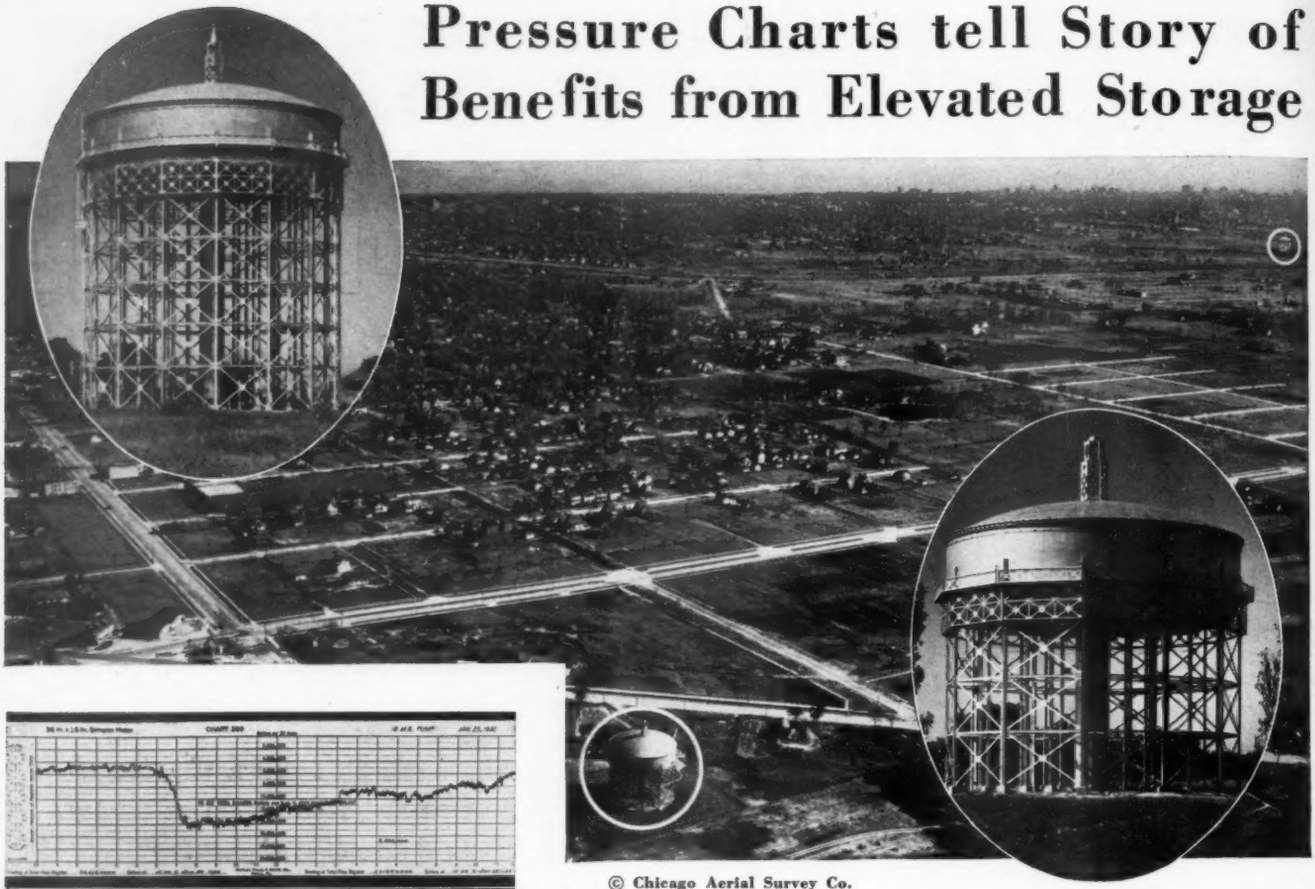
THE COOPER-BESSEMER CORPORATION

Mt. Vernon, Ohio — PLANTS — Grove City, Pennsylvania

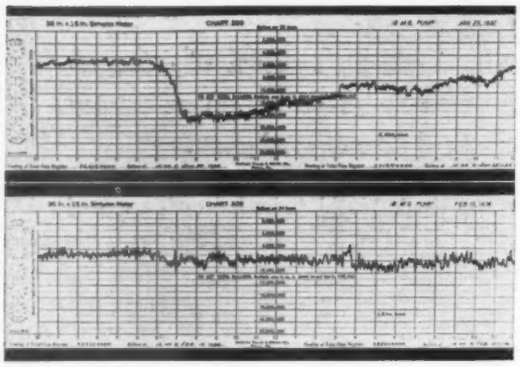
25 West 43rd Street, New York City · Mills Building, Washington, D. C. · 640 East 61st Street, Los Angeles, Calif. · 201 East 1st Street, Tulsa, Oklahoma · 225 Crockett St., Shreveport, La. · 53 Duncan Street, Gloucester, Mass. · Magnolia Building, Dallas, Texas · Esperson Building, Houston, Texas

Gas and Power Equipment Company, Birmingham, Alabama

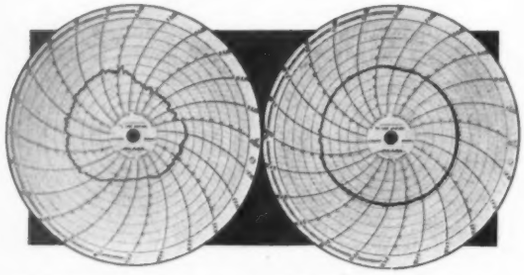
Pressure Charts tell Story of Benefits from Elevated Storage



© Chicago Aerial Survey Co.

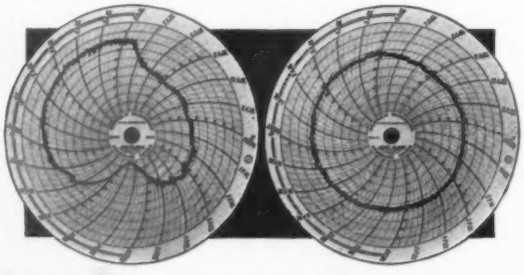


The upper curve shows high lift pumping rates on Jan. 25, 1932. The lower curve is for Feb. 15, 1936.



BEFORE—Pressure record at Washington St. and Dodge Ave. (South Evanston), July 18, 1930.

AFTER—With first tank in service nearby, pressure showed this improvement on July 17, 1935.



BEFORE—Pressure record at Ridge Road and Hartzell St. (North Evanston), May 16, 1934.

AFTER—With second tank in service nearby, pressure showed this improvement on Sept. 18, 1935.

The ability of elevated storage tanks to correct low-pressure conditions and at the same time to smooth out extreme pumping loads has been amply demonstrated at Evanston, Illinois, where the two tanks shown above are located. The one in the upper oval is a 1,500,000-gal. unit which was erected in 1932. In the aerial view of the city, this tank is circled in the distant background. The second tank, which is also visible in foreground of aerial view, is of 1,000,000-gal. capacity and was placed in service in 1935. The accompanying charts, from a report presented at the Illinois Section of the A.W.W.A., give a graphic picture of the results which have been obtained by the installation of these tanks.

The first two charts at the left show the difference in the high lift pumping rates before and after the elevated tanks were installed. In the upper curve the rate varied from 4 to 15 m.g.d. while in the lower it ranged from 6 to 9 m.g.d. with the tanks in service. Total pumpage was approximately the same for the two days.

In the center are two circular charts showing the effect of the first elevated tank on the pressure in the surrounding distribution system. These charts—which were made at the same location, near the first tank—show that the pressure dropped as low as 19 lbs. per sq. in. on July 18, 1930, while it did not go below 45 lbs. on July 17, 1935, with the tank in service. The total pumpage and pumping pressures were comparable for these days.

The lower pair of charts show a comparison of pressures in the extreme northwest section of the city before and after the second tank was installed. On May 16, 1934, the pressure dropped as low as 2 lbs., while at the same place and under the same load and pumping pressure conditions the pressure on Sept. 18, 1935, remained between 27 and 33 lbs.

For complete information on how elevated storage can help solve typical water supply problems, write or call our nearest office.

CHICAGO BRIDGE & IRON CO.

Chicago.....2198 Old Colony Bldg.	Houston.....2919 Main St.
New York...3390-165 Broadway Bldg.	Detroit.....1551 Lafayette Bldg.
Cleveland.....2262 Rockefeller Bldg.	Philadelphia....1644-1700 Walnut St.
Dallas.1479 Dallas Athletic Club. Bldg.	Boston....1548 Consolidated Gas Bldg.
Birmingham.....1586 North 50th St.	San Francisco.....1083 Rialto Bldg.
Tulsa.....1646 Hunt Bldg.	Los Angeles.....1455 Wm. Fox Bldg.

Fabricating Plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

COLUMBIA

Photos courtesy
"U.S. Bureau of Publi · Roads"
"Oregon State Highway Commission"

PERFORMANCE

COLUMBIA LIQUID CHLORINE

(In Single and Multiple Unit Tank Cars, 100 and 150 lb. Cylinders.)

Other COLUMBIA products
SODA ASH
CAUSTIC SODA
SODIUM BICARBONATE
MODIFIED SODAS
CALCIUM CHLORIDE

THE Columbia River Highway, called "America's Greatest Boulevard", is unsurpassed anywhere for scenic grandeur and as a triumph of engineering skill.

Unsurpassed too, is the long continued performance of The COLUMBIA ALKALI CORPORATION in serving industry with unvarying quality products in the alkali field.

Recently, Liquid Chlorine has been added to the line. Produced under ideal conditions at the Barberton plant, this new member of the Columbia family already has given adequate evidence of matching Columbia's enviable performance record.

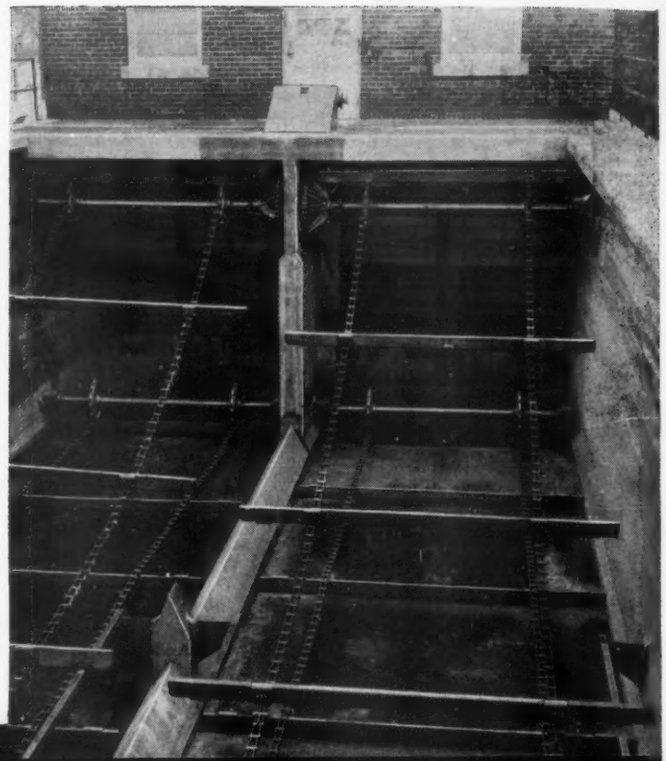
Make your products better and your problems fewer by specifying COLUMBIA.

Send for new folder on COLUMBIA Liquid Chlorine

THE COLUMBIA ALKALI CORPORATION

EXECUTIVE SALES OFFICES 30 ROCKEFELLER PLAZA • NEW YORK, N. Y.
Branch Sales Offices • BARBERTON, OHIO • 451-461 ST. CLAIR STREET, CHICAGO
CAREW TOWER, CINCINNATI • GRANT BLDG., PITTSBURGH • Plant at Barberton, Ohio

HOW TO HANDLE IT IF IT IS WATER



and the debris and suspended matter must be removed . . . .

• The Chain Belt Company has long been a leader in the supplying of equipment for purifying of America's Water Supply.

First came the problem of removing floating debris, to be rapidly followed by the need for sewage disposal, and next, trade wastes and other suspended matter.

Today, Rex Sanitation Equipment is in extensive use, eliminating debris and pollution at the source in sewage disposal and trade waste plants, screening intake water, and removing suspended solids in water works and filtration plants.

The Chain Belt Company will be glad to furnish any desired information on Rex Sanitation Equipment . . . and its application.

These books give basic operating and mechanical data on Rex Sanitation Equipment. Intended primarily to cover the subject of sewage disposal and water treatment, they will also be useful in connection with other phases of trade wastes treatment. Check any or all of them that interest you.

Rex Conveyor Sludge Collectors
Rex Tow-Bro Sludge Remover
Rex Sludge Pumps
Rex Mechanically Cleaned Bar Screens
Rex Intake Screens
Rex Spray Nozzles
Rex Grit Removers and Washers
Rex Triturators (Screenings Shredders)

REX

CHAIN BELT COMPANY of MILWAUKEE

Sanitation Equipment

Notice to Users of

Tegul- MINERALEAD *and*

MINERALEAD

IN THE FLOOD AREAS

If your stocks of Tegul-MINERALEAD or MINERALEAD were submerged during the high water, they have not been injured. These compounds, in INGOT form, are impervious to water. They'll be ready to go to work whenever *you* are.

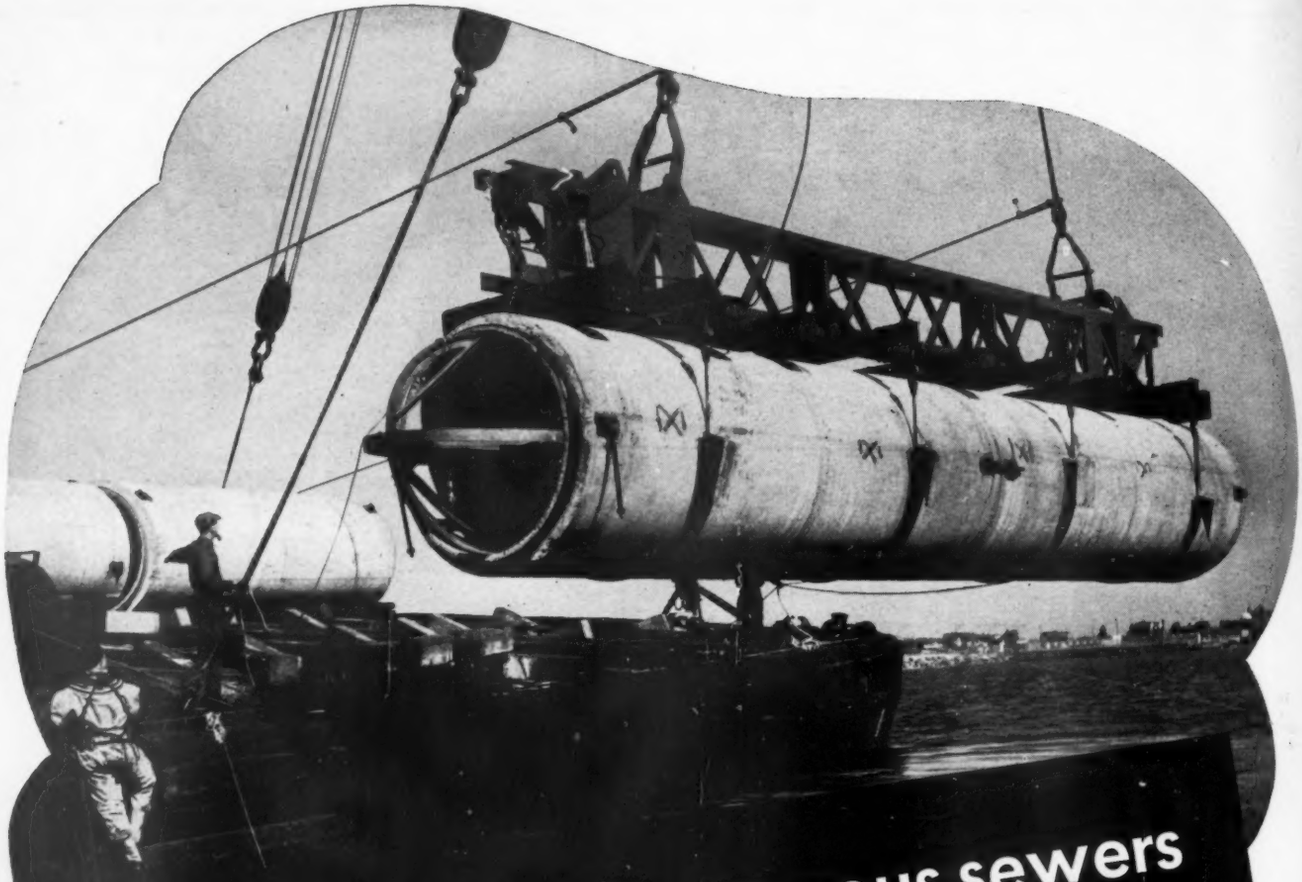
•

Joints made with Tegul-MINERALEAD are tighter from the start. Either compound makes joints highly resistant to vibration and mechanical impact. A further important advantage of the INGOT form is that its composition cannot change between our plant and your job.

•

For more information write

THE ATLAS MINERAL PRODUCTS COMPANY
of Pennsylvania
Mertztown - - - - - - Pennsylvania



Million dollar subaqueous sewers rely on the durability and permanence of CONCRETE PIPE

Two 24-ft. lengths of 72-in. reinforced concrete pipe weighing 44 tons being lowered into position off Coney Island, New York City. This project is being built by City of New York with WPA funds. Thomas W. Hammond, Commissioner of the Department of Sanitation; Walter D. Binger, Deputy Commissioner, in charge of engineering; plant design and construction by Richard H. Gould, Chief Engineer and William L. Sylvester, Designing Engineer; Alfred R. Glock, Resident Engineer.

ABATEMENT of New York harbor pollution and health protection for the millions of bathers at Coney Island beaches required the building of a new sewage treatment plant at Coney Island. And part of that job was constructing a sewer with a 6,375-ft. subaqueous section of 72-in. concrete pipe.

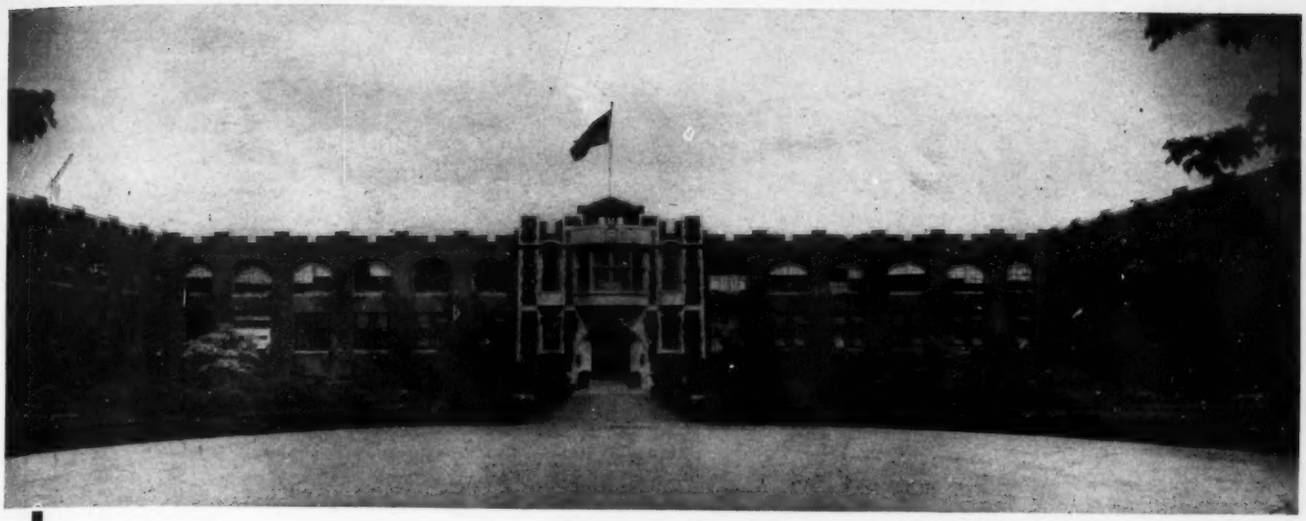
Double 24-ft. sections with watertight joints were lifted and laid with a steel truss "strong back" and the successive sections bolted together by a diver, three 48-ft. sections being laid each working day. With a shell thickness of 7 in. and a weight of 22 tons, these 72-in. pipe sections are believed to be the longest lengths ever cast for pipe of this diameter.

Well-engineered and well-constructed, this job is typical of the many sewers and sewerage systems throughout the country for which concrete is being used. Strong, permanent and moderate in cost, concrete pipe is the answer to a wide range of problems; whether the sewer is 12 inches or 12 feet in diameter.

The cheapest insurance of the success of a sewer job is to place the work in the hands of a competent sanitary engineer.

PORTLAND CEMENT ASSOCIATION, Dept. 2-29, 33 W. GRAND AVE., CHICAGO, ILL.

A National Organization to Improve and Extend the Uses of Concrete



DOUBLEDAY, DORAN & CO.

GARDEN CITY LONG ISLAND, N. Y.

MODEL "C"
PORTABLE

FAMOUS FOR ITS MODERN PRINTING PLANT AND FINE HOMES

IS SERVED BY A MODERN SEWAGE PLANT *using*

A ROYER DISINTEGRATOR

Royer Disintegrator in operation at Garden City, L. I., Plant

IN addition to Garden City, L. I., many of the Nation's important sewage plants have adopted ROYER DISINTEGRATORS as standard equipment. Let us tell you how a ROYER will pay for itself in a short time. Machines made in four sizes—either belt, gasoline engine or electric drive.

Write for details

ROYER FOUNDRY & MACHINE CO.

158 Pringle St. Kingston, Pa.

C. G. WIGLEY, Sole Rep. 3108 Atlantic Ave., Atlantic City, N. J.

Dangerous Waters!

WHEN floods bring the threat of polluted water supplies and of water-borne disease, HTH proves itself an invaluable ally to water works and health officials. With HTH, emergency hypochlorination can be applied quickly, on the spot, wherever pollution is found. A highly concentrated chlorine carrier, containing 70% of available chlorine, quickly soluble in water, HTH can be transported to the job and put to work before a dangerous situation has time to develop.

Then there is the aftermath of flood conditions, as receding waters leave a seemingly hopeless task of cleaning up and disinfecting flooded areas and buildings of every kind. Here again health authorities find HTH of invaluable assistance in restoring sanitary conditions in scores of places where a less concentrated, less mobile or less soluble source of chlorine cannot serve as effectively.

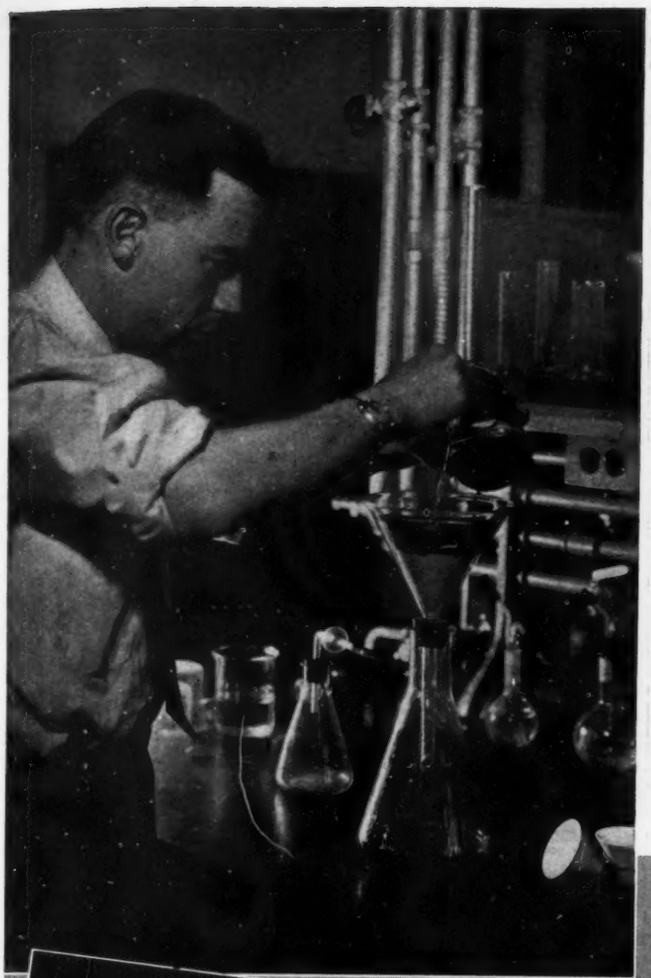
Fortunately, floods do not strike frequently at the average community nor do they strike so quickly as to find local officials wholly unprepared. But there are day-to-day emergencies, too, which require prompt and effective chlorination—broken water mains, an abnormal water load due to a serious fire, polluted wells, failure of a chlorinator, an interruption in the power supply—just the sort of jobs for which HTH is made to order.

No wonder that so many experienced water works men keep an ample supply of HTH always on hand, not only as an important measure of preparedness for every sort of emergency, but also because they find it so useful in scores of every-day sanitation jobs! Write or wire us for full information and nearest available stock.

The MATHIESON ALKALI WORKS (*Inc.*) 60 East 42nd St., New York, N. Y.

Liquid Chlorine . . . HTH and HTH-15 . . . Soda Ash . . . Caustic Soda . . . Bleaching Powder . . . Bicarbonate of Soda
Ammonia, Anhydrous and Aqua . . PH-Plus (Fused Alkali) . . . Solid Carbon Dioxide

BE PREPARED WITH HTH FOR ANY EMERGENCY!



For Municipal Laboratories . . .

Sewerage, Water and Food Control

CRUCIBLES, Cones, Dishes, Discs, Thimbles—the Norton line of refractory laboratory ware is popular in all municipal laboratories for filtrations and extractions. There is a wide variety of sizes and shapes. Cleaning is a simple process of washing and igniting to constant weight.

A special leaflet describes these products in detail—lists sizes and prices. A copy will be sent without charge or obligation.

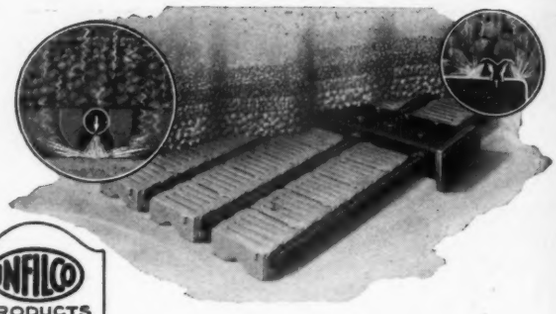
NORTON COMPANY, WORCESTER, MASS.

New York Chicago Cleveland

R559

NORTON PRODUCTS — Grinding Machines; Lapping Machines • Grinding Wheels; Abrasives for Polishing; India Oilstones, Pulpstones • Laboratory Ware, Refractories; Porous Plates • Non-slip Tiles and Aggregates

INSTALLING 20" cement-lined Mono-Cast Centrifugal Pipe (B&S) alongside U. S. Highway No. 52 near Charleston, S. C., replacing a substitute pipe. Water in the Charleston area is highly tuberculating, and some of the first centrifugally cement-lined cast iron pipe was laid there in 1922. For literature on high quality cast iron pipe and fittings (with or without cement lining) address American Cast Iron Pipe Co., Birmingham, Ala.



INFILCO PRODUCTS

Aerators
Automatic Boiler Blowdown
Basin Level Controllers
Chemical Proportioners
Clarifiers
Coagulant Feeders
Dechlorinators
Depth Gauges
Directional Flow Controllers
Disk Filters
Dry Chemical Feeders
Filtration Plants
Filter Underdrains
Flow Indicators
Gravity Filters
Hot-Flow Water Softeners
Hydraulic Valve Controls
Hydrodarco Purifiers
Iron Removal Plants
Loss of Head Gauges
Lime-Soda Water Softeners
Lime Slakers and Feeders
Manometers
Orifice Feed Boxes
Oil Removal Filters
Proportioning Equipment
Pressure Filters
Recarbonating Equipment
Rate of Flow Controllers and Gauges
Sampling Tables
Solenoid Operated 4-Way Valves
Steam and Gas Purifiers
Strainers and Distributing Nozzles
Swimming Pool Filters and Equipment
Sterilizers
Taste and Odor Removal Plants
Venturi Tubes and Orifice Meters
Water Stills
Wet Chemical Feeders
Zeolite Water Softeners

Perfect Wash Water Distribution With Wagner Filter Underdrain

With but fourteen inches of graded gravel, the Wagner Filter Underdrain provides every requirement for perfect wash water distribution—and it follows that it is equally efficient in the collection of filtered water and drainage of the filter.

Its essentials are—(1) the primary distributing system, consisting of header manifold and laterals on wide centers with distributing orifices along their undersides; and—(2) the secondary system consisting of the Wagner precast blocks fitting between the laterals.

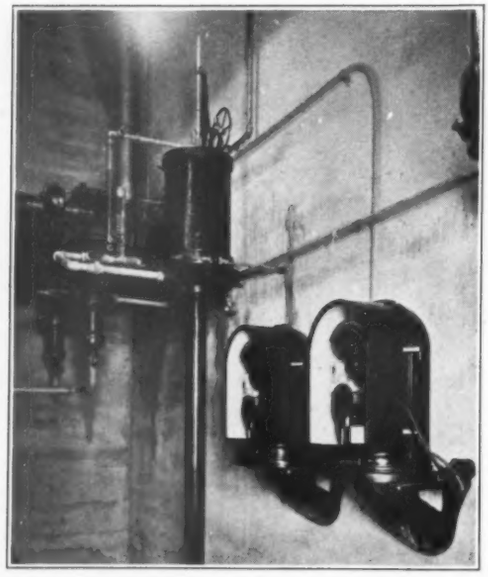
The Wagner Blocks do not change the function of the primary system as the orifice areas in the laterals provide for the essential primary distribution. But, with protected orifices, jet action harmlessly dissipated by the concrete floor; a free-way over the entire filter floor unobstructed by any gravel—any slight differences in pressure are immediately averaged. The Wagner Blocks truly complete the wash water distribution and positively assure uniform upward flow throughout the filter bed.

The efficiency of the Wagner Underdrain can usually be obtained at a saving over conventional systems. Laterals placed on from 12 to 24 inch centers reduce the cost of the primary distributor. The expensive and almost unobtainable large gravel is eliminated. Shallower beds increases the desirable positive head and also permits lowered troughs to reduce wash water pumping head. And, manufacture of the blocks provides work for local labor. Send for Bulletin 82.

INTERNATIONAL FILTER CO.
General Offices:
59 East Van Buren St. Chicago

INTERNATIONAL

THE SIMPLEX EGG-SHAPED Flume Meter



Two Simplex 12x8" Egg-Shaped Flumes and Meters at Hatboro-Upper Moreland Sewage Works, Hatboro, Pa.

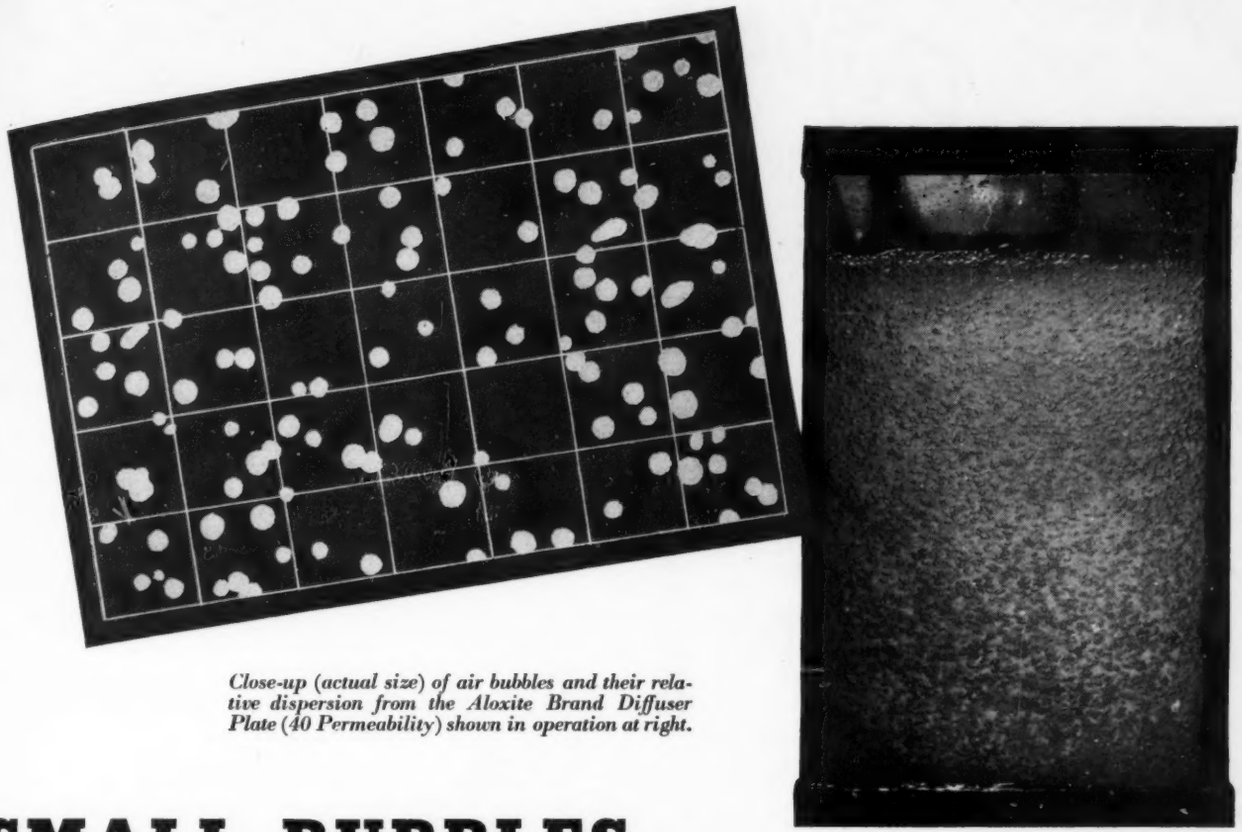
A rated primary device capable of measuring sewage flows with extreme accuracies over wide flow ranges.

Designed for installation on .005 grades, the instrument's response will be within plus or minus 2% over a range of from 100 to 1.

Let SIMPLEX ENGINEERS help you with your metering problems.

SIMPLEX VALVE & METER CO.
6743 UPLAND STREET • PHILADELPHIA, PA.

FORCEFUL FACTS ON SEWAGE AERATION BY AIR DIFFUSION — No. 11



Close-up (actual size) of air bubbles and their relative dispersion from the Aloxite Brand Diffuser Plate (40 Permeability) shown in operation at right.

SMALL BUBBLES *insure* MAXIMUM EFFICIENCY

The rate at which oxygen is absorbed from the air bubbles is of primary importance in the operation of an activated sludge plant. The efficiency of oxygen absorption directly controls the effectiveness and operating cost of the plant.* This efficiency depends on the ratio of surface contact to the volume of air, and is greatest when the size of the bubbles is at a minimum.*

Small bubbles can be produced best by the use of porous diffusers. Experience has shown, however, that the bubble size is at a practical economic minimum when the permeability of the porous plate is approximately 40 to 50.* Lower permeability ratings result in only a very small reduction in bubble size, and have the disadvantage of increasing the pressure drop through the plate to a considerable extent. The problem of how to produce small bubbles without sacrificing low resistance to the flow of air is easily solved by the use of Aloxite Brand Diffusers, manufactured by The Carborundum Company. They have just the right combination of grain structure and bonding agent to give the smallest possible bubbles for a given permeability rating. Specify Aloxite Brand Diffusers and you'll always be sure of getting maximum operating efficiency.

*References available on request.

TUNE IN THE CARBORUNDUM BAND
Saturdays at 7:30 P.M., E.S.T.
Columbia Chain

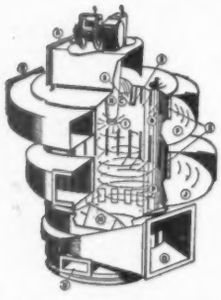
ALOXITE BRAND
REG. U.S. PAT. OFF.
DIFFUSER MEDIA
PLATES AND TUBES

THE CARBORUNDUM COMPANY . . . NIAGARA FALLS, N. Y.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Cleveland, Cincinnati, Pittsburgh, Boston, Detroit, Grand Rapids

(Aloxite is a registered trade-mark of The Carborundum Company)

New UNIT Spray Drying and REACTION CHAMBERS



SIZES 5 and 10
For detailed explanation send for Bulletin No. 3.
PATENT ALLOWED AND PENDING

BOWEN

RESEARCH CORPORATION
GARWOOD, NEW JERSEY

With "CHICAGO" AERATION EQUIPMENT

MECHANICAL AERATION and
AIR DIFFUSION

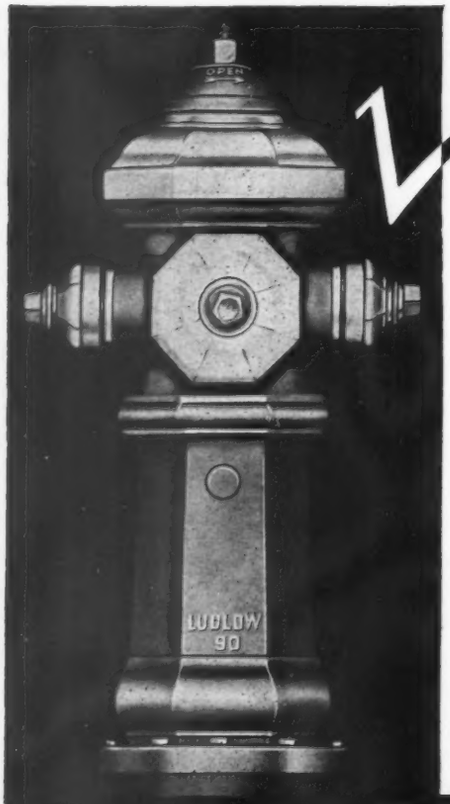
Ask for Complete Information

SEWAGE EQUIPMENT DIVISION

CHICAGO PUMP COMPANY

VACUUM—CONDENSATION—CIRCULATING—BILGE
FIRE — HOUSE — SEWAGE — SCRU-PELLER PUMPS
AERATORS — COMMINUTORS — SAMPLERS

2349 Wolfram St. Chicago, Ill.



Check LUDLOW Hydrants

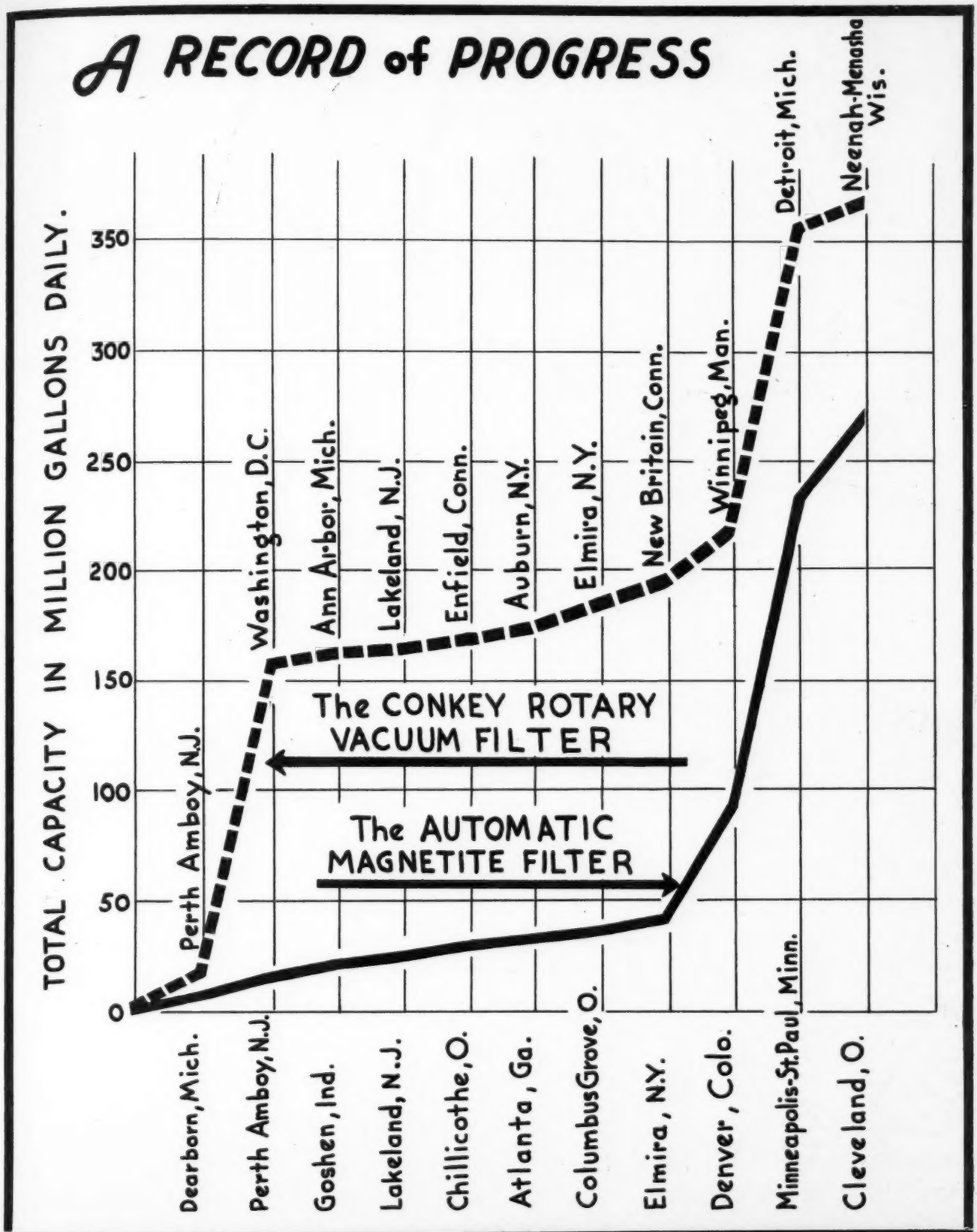
Check these points about the Ludlow No. 90 hydrant—

- ✓ Full force—no obstruction in waterway
- ✓ Non-freezing—drains from bottom
- ✓ Surge and water hammer eliminated
- ✓ Replaceable without digging
- ✓ Parts easily removable—low maintenance

— and finally, the most modern, graceful design obtainable.

SEND FOR FREE FOLDER

The LUDLOW VALVE MFG. CO.
TROY · NEW YORK

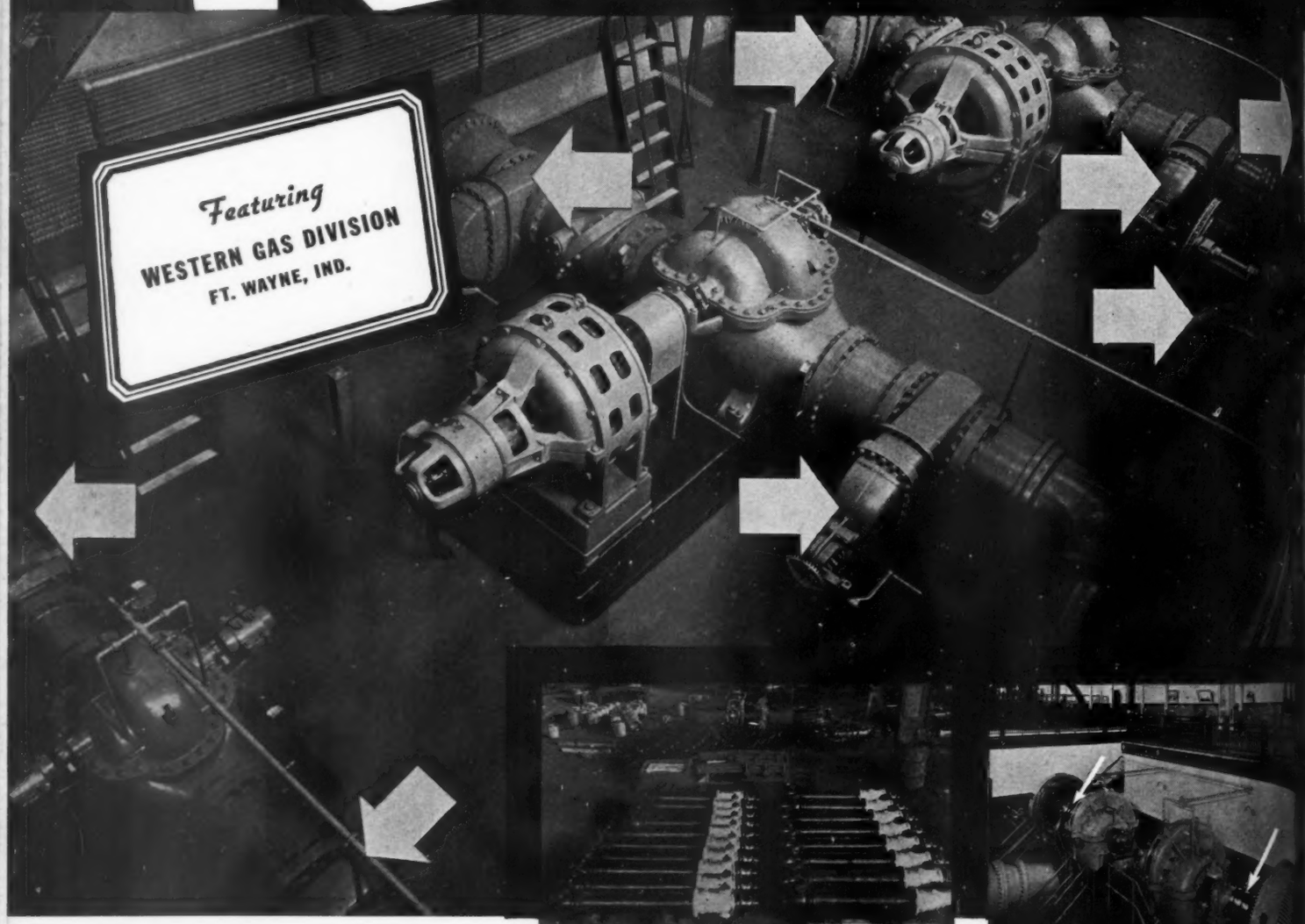


FILTRATION EQUIPMENT CORP.

10 East 40th Street — Sales Office — New York, N. Y.

COARSE SCREENS • AUTOMATIC MAGNETITE FILTERS • CONKEY VACUUM FILTERS

KOPPE



THESE "WESTERN" VALVES (BOTH VERTICAL AND HORIZONTAL) HAVE THE SAME TYPE OF DISCS—This photograph shows WESTERN Valves in the filtration plant of the City of Hammond, Ind. WESTERN valves are installed in a horizontal as well as vertical position. Yet all have the same design bodies, discs and wedging mechanism. The discs are suspended at their centers which allows free rotation in opening and closing, and eliminates the need for rollers, scrapers and tracks for the discs when the valve is installed in a horizontal position. WESTERN Gate Valves are supplied for operation with handwheel, bevel gear, spur gear, electric motor, and hydraulic or pneumatic cylinders. Western Gas Division of Koppers Company makes valves to your order.

THE STEM THREADS ON THESE FIRE HYDRANTS WILL NOT CORRODE OR FREEZE—WESTERN Hydrants (built by Western Gas Division of Koppers Company) have the operating unit removed from the water zone, and provision is made for lubrication of the operating elements. If the hydrant is broken, the compression type valve is held against its seat by the water pressure, and flooding is prevented.

THIS CITY PUMP HAS FAST'S SELF-ALIGNING COUPLINGS—These Fast's Couplings, as manufactured exclusively by the Bartlett Hayward Division of Koppers, Baltimore, Md., are all-metal, lubricated couplings of the double engagement type. They have eliminated troublesome operating conditions in many plants. This photo was taken in the Detroit Pumping Station.

ERS

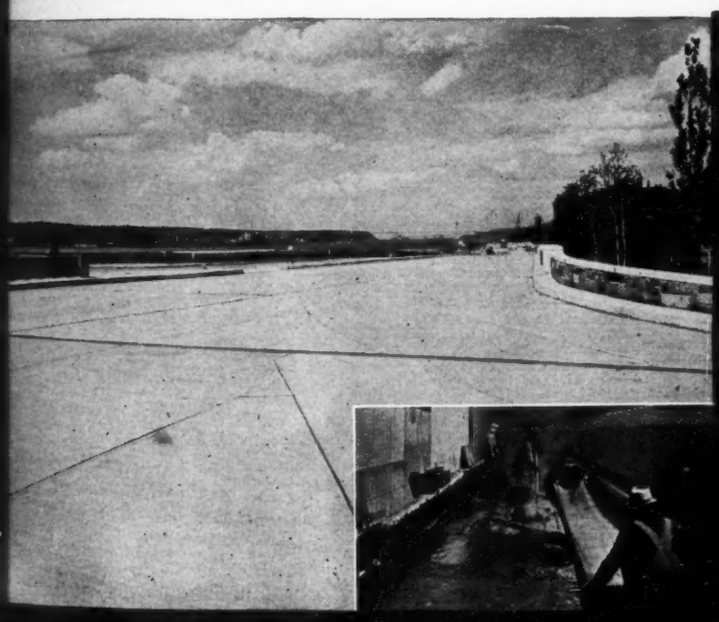
Koppers Divisions, Subsidiaries and Affiliates in the Public Works field:

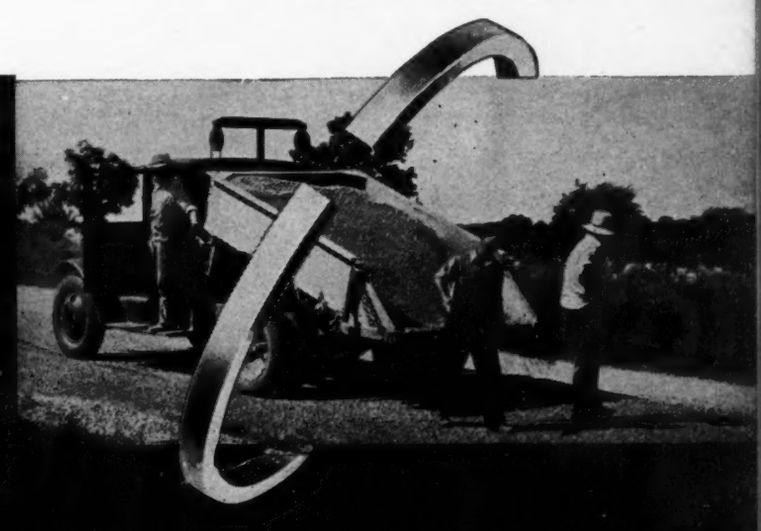
WESTERN GAS DIVISION
HILER ENGINEERING AND CONSTRUCTION COMPANY
TAR AND CHEMICAL DIVISION
THE WOOD PRESERVING CORPORATION
BARTLETT HAYWARD DIVISION
AMERICAN HAMMERED PISTON RING DIVISION
THE KOPPERS COAL COMPANY
THE MARYLAND DRYDOCK COMPANY
THE WHITE TAR COMPANY OF NEW JERSEY, INC.

THIS PLANT IS EXPECTED TO SAVE PROVIDENCE $100,000.00 A YEAR—Garbage burned in this incinerator at Providence, R.I. (a new type just built by a Koppers subsidiary, the Hiler Engineering and Construction Company, Pittsburgh) generates all power requirements of the incinerator plant, as well as the sewage disposal plant and sewage pumping station.

CASTS TUNNEL LINERS—In its Bartlett Hayward plant at Baltimore, Koppers makes huge cast iron rings, as shown in this photograph for tunnel liners. (Man in foreground indicates size of this liner.)

TARMAC USED IN SOIL STABILIZATION—In the past several years, Koppers has pioneered in soil stabilization with Tarmac. Stabilized roads now in successful service for some time indicate that this method of construction will revolutionize road building.





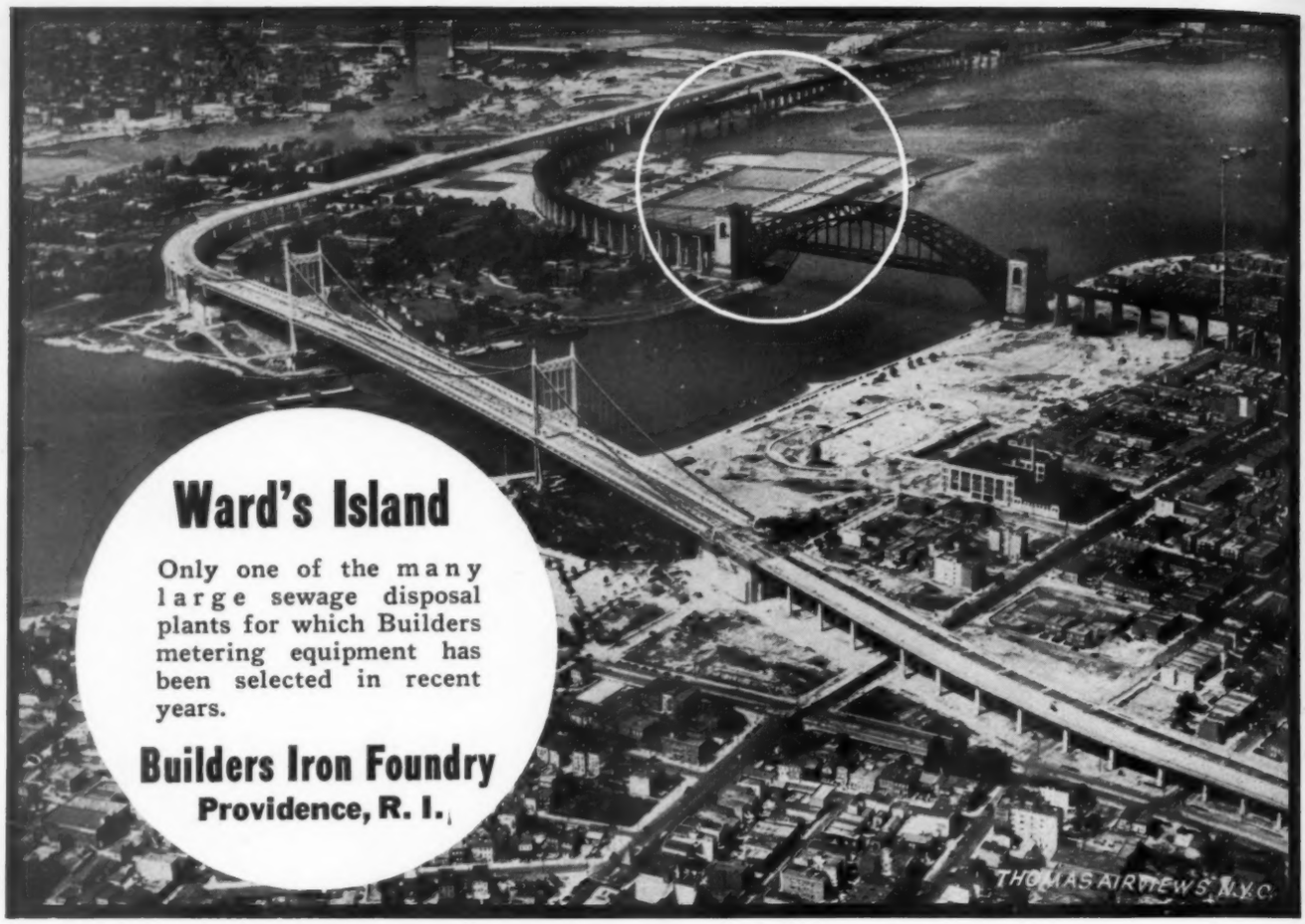
WS-2

KOPPERS COMPANY, Pittsburgh, Pa.
Please send me information on:

- ☐ Coal
- ☐ Coal Tar Roofing
- ☐ Creosote
- ☐ Dampproofing
- ☐ Disinfectants
- ☐ Insecticides
- ☐ Fast's Couplings
- ☐ Fire Hydrants
- ☐ Gas Holders
- ☐ Municipal Incinerators
- ☐ Pipe
- ☐ Piston Rings
- ☐ Sewage Disposal Equipment
- ☐ Signal Buoys
- ☐ Sluice Gates
- ☐ Tanks
- ☐ Tarmac Road Tars
- ☐ Tarmac Handbook
- ☐ Treated Timber
- ☐ Tunnel Liners
- ☐ Waterproofing
- ☐ Waterworks Gate Valves
- ☐ Weed Killers

.....

.....



Ward's Island

Only one of the many large sewage disposal plants for which Builders metering equipment has been selected in recent years.

Builders Iron Foundry
Providence, R. I.

LFC

A White Elephant for many Foundries but an everyday job for **LYNCHBURG**

40" x 30" x 30" Flanged Ribbed Wye Bends

Its huge, odd shape would have made this SPECIAL CASTING a White Elephant for many foundries, but here at "Lynchburg" with more than half a century of successful experience in casting difficult special fittings it was but another everyday job. . . . Play Safe —write, wire or phone your specifications to "Lynchburg" for quick estimates.

Bell and Spigot Pipe and Fittings. From 4" to 54"
Cast Iron Flanged Pipe. From 3" to 84"
Cast Iron Flanged Fittings and Flanges from 1" to 84"
de Lavaud Centrifugal Cast-Iron Pipe

LYNCHBURG FOUNDRY COMPANY

General Office - Lynchburg, Virginia

Peoples Gas Building
Chicago, Ill.

50 Broad St.
New York, N. Y.

WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"Water Loss and Leakage Control" is a contribution from Johannesburg, South Africa. Mr. M. Udwin, Rand Water Board's Chief Engineer relates their experiences with leakage control and tells how it has been possible to reduce unaccounted for water (water loss) to the extraordinarily low figure of 1.34 per cent. More remarkable, is the fact, that this becomes a sustained efficiency in the operation of Mr. Udwin's distribution system. It would appear that America has something to learn from the Transvaal.

"Some Considerations in the Design of Small Sewage Works" is to be presented by W. B. Walraven, America's "Ace" in sludge-gas power-engineering, of Springfield, Ill. He contends that, this is a story often told; but agrees that it needs re-telling. In the present day of development and change in sewerage practice and sewage treatment, Mr. Walraven's article based on practical operating experience and design, and the observations of a student, all go to the making of his article one well worth the "re-telling"—and, re-reading. If every designing engineer had to pass through an operating apprenticeship, their drafting boards would the better plants produce. To read Mr. Walraven's article is to take a post graduate course in sewage works design.

"Pipe Line Corrosion Control" is the subject of an article by Sheppard T. Powell, Baltimore Chemical Engineer, which relates a method of corrosion suppression involving mechanical de-aeration and chemical deoxygenation of water entering a long line. Results are presented which cover a period of sufficient duration to reveal definite technical effects and economic considerations.

"Recent Methods of Financing Sewage Works" from C. W. Klassen, Chief Engineer, and Homer W. Wisely, Assistant Engineer, of the Illinois State Department of Health is a review of recent developments in, and experiences with, financing new sewage works and procuring sewerage betterments. Their paper deals principally with experiences of Illinois communities since the 2 year old legalization of revenue bonds for utility betterments. They find that with the more general acceptance of revenue bonds as high grade municipal collateral, sewerage betterments become the simpler to secure. The practical features of a combination of water works and sewerage operation and financing are discussed. The results are well worth the telling.

"Experiences in Well Construction" by Jas. A. Carr, Superintendent of Water at Ridgewood, N. J., embraces several worthy observations and suggestions of a practical nature, based on the author's experiences in choice of location, drilling and developing deep wells.

"A Novel Method of Scouring and Flushing Small Mains" will be described by Richard F. Brown, Plant Manager, California Water Service Co. Practical, effective, economical; the procedure involves the simplicity of "shooting" the mains with high velocity scouring injections of compressed air followed by flushing. Mr. Brown's article, long scheduled, has been held for a more timely issue when warm weather problems on dead-ends become the most accute.—Ed.

CONTENTS for FEBRUARY, 1937

Vol. 84, No. 2

Sewerage and Sewage Treatment in Review—Some Comments 33
By CHARLES GILMAN HYDE
Professor of Sanitary Engineering, University of California, Berkeley

How Much Water Do We Consume—What Do We Pay for It 40
By CHARLES H. CAPEN, JR.
Engineer, North Jersey District Water Supply Commission, Newark, N. J.

Dry Cleaning Air Diffuser Plates 44
By A. M. RAWN
Los Angeles, Calif.

Thawing Service Pipes—A Review 45
By FRANK C. AMSBARY, JR.
Supt., Illinois Water Service Co., Champaign, Ill.

Annual Meeting New York State Sewage Works Association 49

The Effect of Activated Carbon on Sludge Digestion 56
By C. E. KEEFER and HERMAN KRATZ, JR.
Bureau of Sewers, Baltimore, Md.

Practical Electricity in the Plant 59
By MARSDEN C. SMITH
Engineer, Water and Electricity, Department Public Utilities, Richmond, Va.

Coagulation: Effect of Silica on Aluminum Hydroxide Coagulation . 61
By JOHN R. BAYLIS
Physical Chemist, Division of Water Purification, Department of Public Works, Chicago, Ill.

Phoenix Sewage Plant Gets Much Needed Detector 67
By DARIA TRAVAINI
Supt. of Treatment Works, Phoenix, Ariz.

A Sprinkling Filter That Would a Swimming Pool Be 69
By LEVI GOODRICH
City Engineer, Mailin, Tex.

Editorial 70

Equipment News 64

Catalogs and Literature Received 66

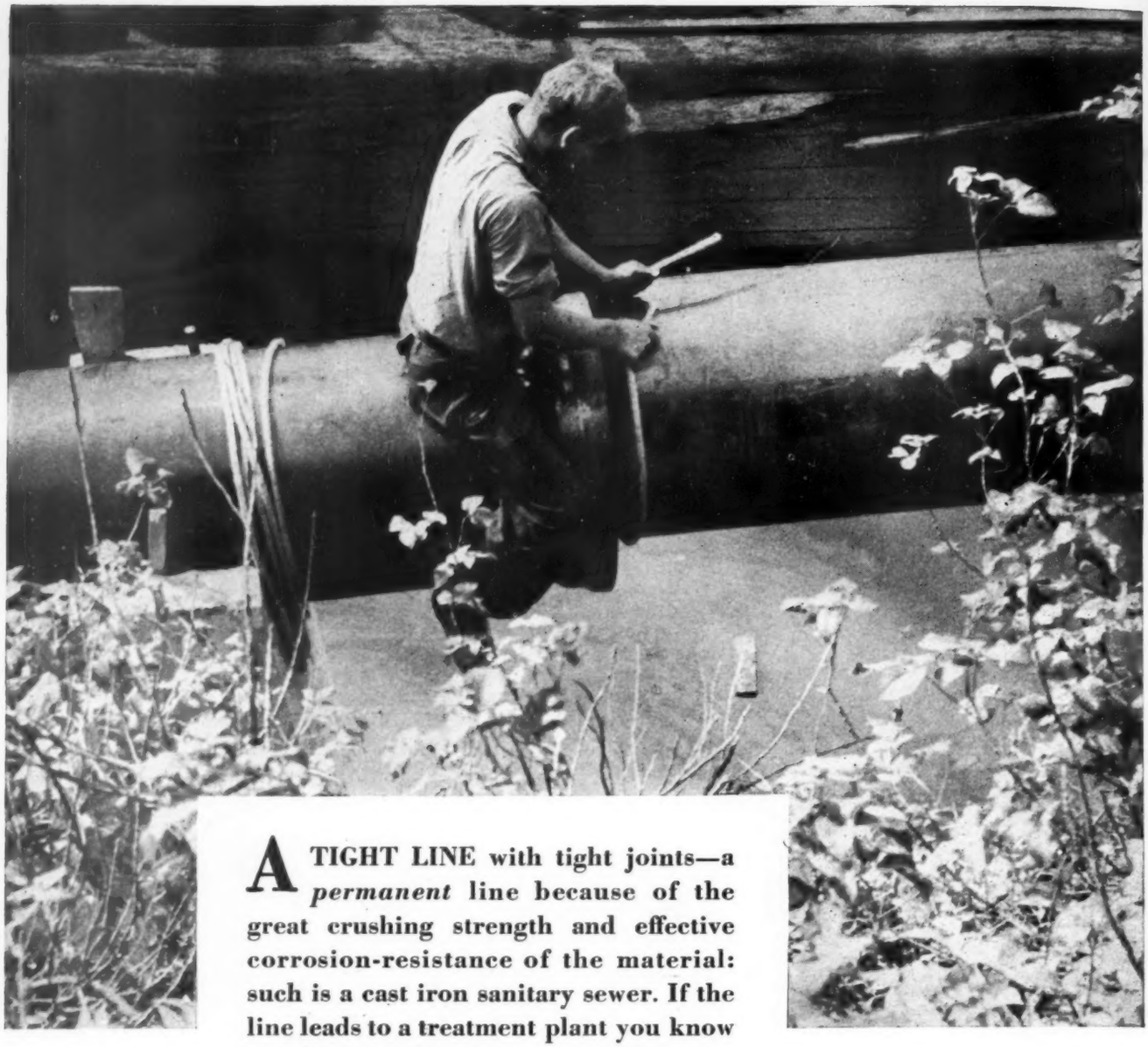
Published monthly by the GILLETTE PUBLISHING CO., Daily News Building, Chicago, Ill.

Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Published monthly at 400 W. Madison Street, Chicago, Ill. Per Copy, 25c. Subscription rates $2.00 per year. Canadian and Foreign, $3.00 per year. Copyright, 1937, by Gillette Publishing Company. Publishers of: Water Works and Sewerage, Roads and Streets, Sporting Goods Journal, Mida's Criterion, Oil and Soap, Powers' Road and Street Catalog and Data Book.

HALBERT P. GILLETTE, Pres. and Editor in Chief; E. S. GILLETTE, Vice-Pres. and Publisher; L. H. ENSLOW, 155 East 44th Street, New York, N. Y., Vice-Pres. and Editor; J. M. ANGELL, JR., Eastern Manager; T. F. KILROE, New England Representative; C. T. MURRAY, Managing Editor; JOHN R. BAYLIS, Associate Editor; D. G. LEDGERWOOD, Make-Up Editor.

Chicago Office, 400 W. Madison Street. Cleveland Office, 1601 Lauderdale Avenue, Lakewood, Ohio. New York Office, 155 East 44th Street. San Francisco Office, 155 Montgomery Street. Los Angeles Office, 318 W. Ninth Street.

Addresses will be changed as frequently as desired, upon notification; not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Water Works and Sewerage*, in order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.



A TIGHT LINE with tight joints—a *permanent* line because of the great crushing strength and effective corrosion-resistance of the material: such is a cast iron sanitary sewer. If the line leads to a treatment plant you know it will be infiltration-proof. With cast iron pipe in the plant itself and cast iron influent lines, a sure foundation is laid for economical, efficient operation and lowest ultimate investment cost. For further information, address The Cast Iron Pipe Research Ass'n., Thos. F. Wolfe, Research Engineer, 1013 Peoples Gas Building, Chicago.

CAST IRON

Installing cast iron pipe for pressure sewer leading to treatment plant at Highland Park, N. J.

CAST IRON PIPE

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 84 FEBRUARY, 1937 No. 2

SEWERAGE AND SEWAGE TREATMENT IN REVIEW—SOME COMMENTS (Part I)

By CHARLES GILMAN HYDE
Professor of Sanitary Engineering, University of California, Berkeley

The Author

THE arts of sewerage and of sewage treatment are by no means static. However, the conditions are such that sewerage, particularly with regard to the smaller conduits and their accessories, is a much more standardized procedure than is sewage treatment; whereas the latter is continuously extending in scope and becoming more complicated. The demands are increasingly exacting in many respects and the professions involved, and the operators, are responding to these requirements. Hence, innumerable contributions are being made. The chemistry and biology of sewage and sewage treatment are subjects of study, both at home and abroad; laboratory technique is improving here and elsewhere; mechanisms of all sorts are being developed as operational aids and controls; plant flexibility is being stressed; hydraulic architectural and structural design is advancing; works areas are being planted and otherwise beautified; the character of operation is gradually being bettered.

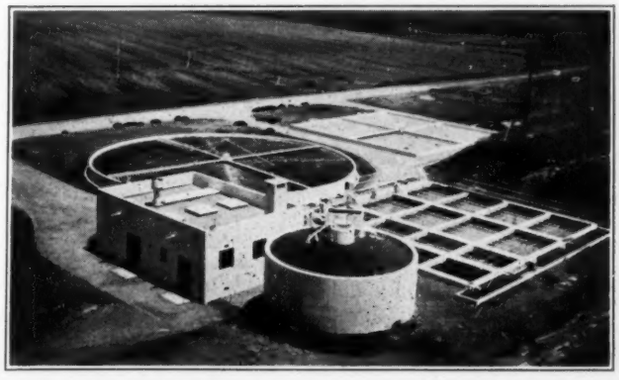
The scope of this article must be limited, and, therefore, it should be regarded as a more or less desultory series of comments on certain phases of this involved subject. To cover comprehensively present day opinions and recent progress would require a volume. In this connection it may be of interest to note that Sewage Works Journal for 1936 contained 1040 pages, with 94 special articles, 95 abstracts and reviews, and 140 references to articles in this field published in five American periodicals. Public Health Abstracts for 1936, under the caption "Sewerage, Sewage and Industrial Wastes," cover 371 titles and comprehend 133 closely written mimeographed pages.

Sewerage

Perhaps the most noteworthy recent advances in the general field of sewerage have been in the design of storm water conduits, of pumps and pumping stations, and of flow measuring devices. The Venturi flume developed by Palmer and Bowlus, of Los Angeles, has a wide field of application in sewers already constructed. It has the advantages of generally sufficient accuracy, simplicity and cheapness, coupled with a very small loss of head. The improved Parshall flume is peculiarly adapted to sewage treatment plants. The Sutro weir, whose flow characteristics have recently been determined by Mavis and his associates at the Iowa Institute of Hydraulic Research, may also be found useful in particular situations.

Much remains to be done to properly protect concrete sewers from disintegration and to develop a cement which shall be highly resistant to the effect of hydrogen sulphide gas. When plastics or synthetic resins are developed to the point where they are sufficiently cheap, it may be found that sewers can be lined with some such material, particularly above normal water surfaces. The manufacture of cements for particular purposes is in its infancy. It is quite within reason to anticipate the commercial production of a cement which will be far more resistant than is any portland cement yet available for sewer construction.

Sulphates in the water supply and their subsequent breakdown by bacteria in the sewage are largely responsible for hydrogen sulphide production in sewers and at treatment works. Time (retention in the sewers) and temperature are of course major factors. For exple, where difficulty has been had with hydrogen sulphide in one instance, no important source of sulphur was



A New Plant Makes Use of High Rate Bio-Filtration. Filter 85 Ft. Diameter—Only 3 Ft. Deep. Camarillo State Hospital, California.

What Sewage Treatment Did for One Town

A Spot in Mamaroneck, N. Y., on the Water Front, "BST" (Before Sewage Treatment).

Three Years Later, the Same Spot, "AST" (After Sewage Treatment).

One Would Hardly Recognize in This "Light House" a Camoflauged Incinerator Stack; in the Building a Treatment Plant

found in the trade wastes, and the water supply which contained 400 p.p.m. of sulphates was found to be the source of the sulphide.

Stale sewage with a high hydrogen sulphide content has caused rapid deterioration of concrete sewers of presumably good construction in many places. A recent example of excessively rapid corrosion is to be found in Arizona. At the worst place the pipe shell thickness is said to have been reduced two inches. On one or more long trunk sewers in California it is hoped that it may be found feasible to limit or halt disintegration by valve control to maintain, continuously or at frequent intervals, the hydraulic grade line above the crown of the conduit. Thereby, the exclusion air (oxygen) is expected to prevent acid formation now produced by sulphide oxidation.

Safe working conditions in sewers are now receiving much deserved attention in America and elsewhere. A number of serious explosions have occurred in the sewers of Ottawa, attributed to gasoline. Explosions and asphyxiations have been all too frequent in sewers elsewhere. Safety lamps and oxygen deficiency and combustible gas indicators, requiring only one minute for a test, are being more generally employed. Various schemes of blowing or exhausting gas-laden air from a given section of sewer or pits are now being utilized in a number of places.

For some years liquid chlorine has been used to eliminate odors and prevent the distintegration of sewers by hydrogen sulphide gas. More recently ferrous chloride, made by the Scott-Darcy process which involves passing of chlorine water through a tower filled with iron scraps, has been found cheaper and a more effective use of the chlorine. The reason seems to be that the iron salts have no affinity for organic matter, as has chlorine, and are consequently available to react with the hydrogen sulphide then present—and, equally important, that later formed. With aeration or prechlorination at the treatment plant the applied iron may have distinct value as a precipitant. In sewages treated by the activated sludge process or on trickling filters iron has a noticeably beneficial effect.

Every effort made by a community to prevent grease, gasoline and oil from entering its sewerage system will undoubtedly be found to have been a good investment as related to treatment plant operation.

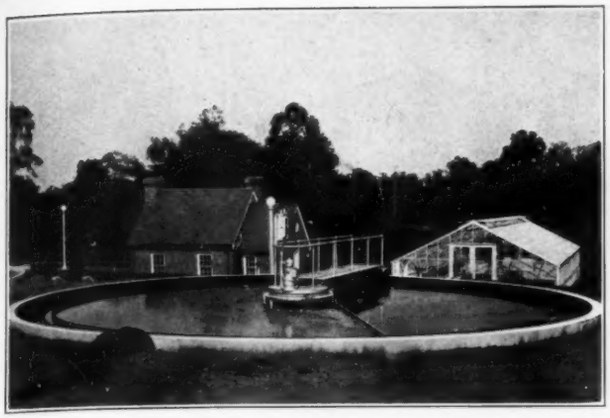
The cleaning of sewers up to 30 inches in diameter by the use of lightly inflated burlap covered rubber beach balls has proved effective in the hands of Rawn and his associates in the Los Angeles County Sanitation District.

Lane and Baldwin of the University of Iowa have recently conducted an illuminating series of observations of flush-wave velocities in small sewers on low grades in Iowa City and have contributed a valuable discussion of the hydraulic principles and phenomena involved. They have concluded that, on flat slopes, flushing volumes varying from 170 to 310 gallons are effective for short distances only and these distances depend upon the sewer gradient, the flushing volume and the depth of natural flow in the sewer at the time of flushing. This writer is aware of virtually no other published technical discussions of this subject since the classical experiments at Ithaca in 1897, 40 years ago, made and reported by Professor Ogden, and the observations and theoetrical consideration of the matter by Asa Phillips at Washington, D. C., in the following year.

Sewage

In recent years, many municipal sewages have changed greatly and in general have become more complex. This change has been brought about by trade wastes which, due to their volume and character, may dominate the sewage of a community. Increased attention must be and is, in fact, being given to these wastes and to the problems of treatment which their presence entails. Most trade wastes are more difficult of effective treatment than is ordinary domestic sewage. Among others, cannery wastes have increased in volume and variety, and in recent years, canneries have been vastly extended in locale. New products of manufacture give rise to new trade wastes: new at any rate in the community in which such enterprises become established.

Engineers have perhaps been too prone to design treatment plants on the basis of the quantitative rather than the qualitative load which must be handled. Killam and others have done well to call attention to the great disparity which may exist between such loadings. Even with strictly domestic sewages, particularly from moderate sized sewerage systems, the maximum daily weights of suspended solids and B.O.D. may be several times the average daily values and many times the minima. This condition may be seriously exaggerated if trade wastes are discharged in batches and are not regulated in volume over the longest possible periods. It is un-



Representative of the Many 1936 Plants for the Smaller Communities Is the 0.5 M. G. D. Culpepper (Va.) Plant. Prechlorination Adds Odor Free Operation to Its Attractiveness and Efficiency.

fortunately the case that the strongest domestic sewage is apt to appear when the rate of flow is high, frequently at or near the daily maximum.

Trade wastes may be, and often should be required to be, pretreated at the point of origin in order to relieve the community's sewage treatment plant of what may well be considered an unnecessary burden. It is believed that such requirements are being laid down in England to a greater extent than in America. With the development of mechanical grinders canneries are now discharging into sewers enormous quantities of solid material which formerly were disposed of otherwise. It is difficult to envision the logic, from the standpoint of the community, in this situation. Some of this material can readily be disposed of as animal foods. The remainder can be gotten rid of by sanitary fill or as a contribution to the solid refuse of the municipality.

Garbage in Sewers

Only three years have elapsed since the proposition of grinding garbage and discharging it into municipal sewerage systems was seriously advanced. During that interval the proposal has been the subject of a considerable amount of discussion and has developed its ardent advocates—and, its equally determined opponents. Various laboratory and plant scale investigations have been conducted. These in the main have attempted to determine the effect of garbage upon treatment plants, particularly as respects sedimentation and sludge digestion. Several excellent technical papers have recently been published.

In general two schemes of garbage disposal with sewage have been suggested and have in some measure been adopted. One plan proposes that the grinding and discharge of the garbage to the sewer be accomplished by the householder on his own premises. The other contemplates the collection and delivery of the garbage to some central grinding station or stations, whence it would be discharged directly into a main sewer having a sufficient velocity and adequate capacity. Earliest studies considered the possibility of disposing of ground garbage by directly digesting it in combination with sewage sludge.

In March, 1935, the city of St. Louis, as an emergency undertaking, constructed a central grinding station to which all of the garbage of the city was delivered and from which it was discharged into a sewer, thence untreated to Mississippi River. The operation has been reported to be successful and it is understood that the program has been permanently adopted.

Herberger's survey of refuse collection in New York State indicates the average per capita daily contribution of garbage to be 0.68 lb., with maximum and minimum values of 1.17 lbs. and 0.44 lb. respectively. Cohn's observations in his own home suggested an average daily weight of 0.5 lb. per capita and Rogel obtained a value of 0.55 lb. Cohn determined that the garbage contained 25 per cent solids of which 85 per cent was organic material. The amount of flushing water utilized in the process of grinding was 1.25 gals. per capita per day.

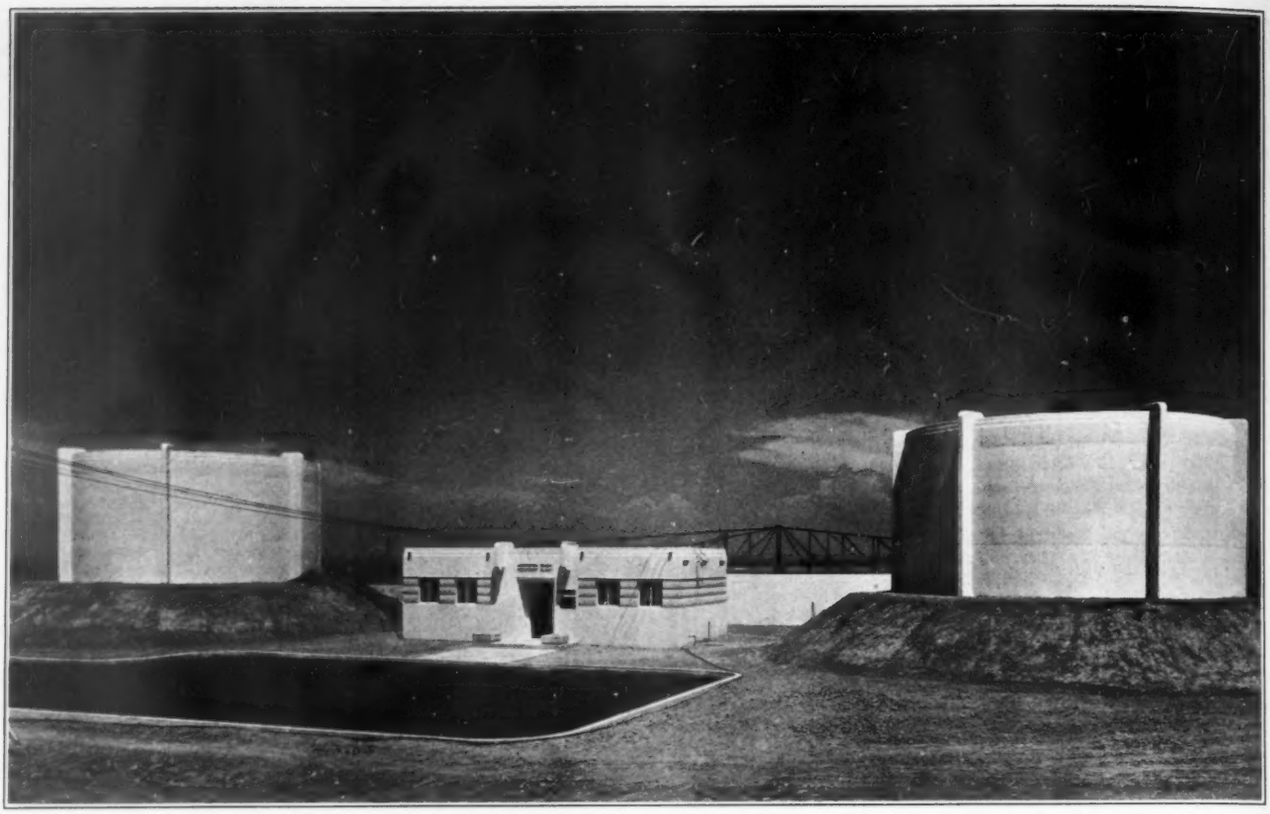
Studies conducted by Babbitt at the University of Illinois led him to conclude that if all of the garbage of a community were discharged to the sewers, both the total and volatile solids would be doubled, the grease content would be more than doubled, and the B.O.D. increased 25 per cent. Carpenter, Rogel and Grabois at New York University, as the result of laboratory analyses and experiments, conclude that if 0.5 lb. per capita per day is added to a typical American sewage, the B.O.D. of the untreated mixture will be about 30 per cent greater than that of the sewage alone. Cohn estimates this value to be 20 per cent. Obviously the actual effect in any given case will depend upon the volume and strength of the sewage and upon the weight and character of the garbage added. The weight of garbage is apt to be enormously increased during the summer and fall months when receiving streams, in some climatic zones at any rate, may be at minimum stages.

Carpenter and his associates verify the conclusions of other observers with reference to the digestion of garbage with sewage sludge. They found that the evolved gases had the same composition and heat value as those from sewage sludge alone and that their volume was increased proportionally to the weight of garbage added. They state that ground garbage mixed with sewage will settle readily but the supernatant liquor will contain a greater weight of total solids and the B.O.D. will be increased in the ratio of the volatile solids added.

Even this very brief survey would be inexcusably incomplete if reference were not made to the pioneer work done by Keefer and his associates at Baltimore, and by Calvert and Tolman at Indianapolis. At Baltimore the garbage grinding experiment was conducted only with the excess garbage which could not be handled at the municipal incinerator. The ground garbage to that extent is reported not to have affected the proper functioning of the trickling filters.

During the summer of 1935 garbage was ground and discharged into a sewer delivering to the activated sludge plant at Durham, North Carolina. The experiment was declared to be a success in that the plant performance was satisfactory and the production of digester gas was increased to such extent that the gas engine power was not only sufficient to operate the works but an excess of electrical energy was delivered occasionally to the municipally owned hydro-electric power distribution system.

The plant scale observations of Calvert and Tolman at Indianapolis were maintained for a relatively long period (7 months, June-December, 1935) and were so thorough in their mechanical and laboratory analytical aspects as to be uncommonly convincing. The entire garbage contribution of the city was ground and discharged to the sewage treatment plant. Studies were made to determine its effect upon the bio-flocculation (short period aeration process, without return sludge) and on the conventional activated sludge process conducted in a unit maintained for experimental purposes. The per capita contribution of well segregated garbage averaged 0.4 lb. per day, with a maximum week's record, during the summer of 1935, of 0.8 lb. and a maximum



At Huntington Beach, Calif., a New Plant Both Modernistic and Modern in Every Respect. Rotary Sprinkling Filter; Enclosed Clarifier (Right); Digester (Left); Capacity 1.5 M. G. D.

daily value, during that period, of about 1.0 lb. The average weight of garbage was calculated to yield 0.03 lb. per capita per day of B.O.D., a value equivalent to but 11 per cent of the average B.O.D., of the fairly strong Indianapolis sewage. The observations demonstrated the importance of fine grinding to the degree that it would pass through 0.25-inch openings in the triturator of Jeffrey type. This fine grinding reduced the volume of floating solids to a negligible amount; improved the organic content of the grit, as compared with coarse grinding; and seemed actually to promote a rapid and more complete settling of the solids in short period (20 minutes) sedimentation units. While the operation of the activated sludge process was not improved by the presence of garbage, there was no indication that the process was disrupted thereby. Estimates apparently made with some care indicated that the disposal of garbage with sewage under Indianapolis conditions could be done at a net cost (recognizing a saving on haulage charges of $0.40) of $0.17 per ton of green garbage, as compared with an actual average net cost of $3.38 at the former reduction plant, and a roughly estimated cost of $1.85 by incineration, including interest and depreciation charges in all cases.

Ehlers, State Sanitary Engineer of Texas, states that of the 345 cities in Texas provided with treatment plants in 1935, 100 had plants which were inadequate to handle the imposed load. It is apparent that the contribution of any substantial additional amount of garbage to the sewage of those communities would constitute an intolerable burden unless, or until, the plants have been improved or extended accordingly. Texas is not alone in this condition.

The discharge of garbage to sewers is a matter which must not be lightly undertaken. It should not be embarked upon unless a comprehensive survey of all controlling factors shows it to be economically and esthetically feasible.

Sewage Treatment Research

Sewage treatment research continues at a progressive rate. Certain of the investigations are so fundamental that their practical application is not immediately apparent. This is as it should be. On the other hand many are intensely practical and relate to some detail of design or operation which insures instantly improved results. This again is as it should be. All such studies are valuable. Without them progress would be impossible or so slow as to be disheartening. Our earlier experiences in sewage treatment are sufficient evidence on this point.

Arising out of the prolonged, painstaking researches of the Stream Pollution Investigations Laboratory of the United States Public Health Service have come in the recent past a number of valuable discussions relating to the pollution and self-purification of streams and to certain phases of sewage treatment. At this laboratory a zooglea-forming bacterium has been isolated in pure culture from activated sludge. This organism produces a floc which simulates activated sludge and is able to remove, during a three-hour aeration period, from 41 to 84 per cent of the oxidizable material present in the polluted water. It is believed that this discovery may prove to be of significance in sewage treatment processes involving biological activity. It has also been announced by these Public Health Service investigations that the absorbent principle in activated sludge has been definitely identified as that of zeolitic exchange which is paralleled by the base exchange effected by the zeolites of softening and iron removal value in water treatment. Other important observations, such as those on the progressive changes in the B.O.D. of polluted streams, have

been made and rational methods have been devised for caluculating the deoxygenating effect of sludge deposits.

An immense amount of fundamental and greatly needed research has been done in the laboratories of the Division of Water and Sewage Research of the New Jersey Agricultural Experiment Station operated in cooperation with Rutgers University. Many large scale experiments of great worth have been conducted by the Sanitary District of Chicago. The operating sewage treatment plants at Aurora, Baltimore, Chicago, Decatur, Indianapolis, Los Angeles (County Sanitation Districts), Plainfield, Springfield and elsewhere in America; at Birmingham, Bradford, Manchester and other places in England; at Essen-Rellinghausen and elsewhere in Germany have been veritable proving grounds for many new ideas relative to sewage treatment and disposal.

Sewage Works Laboratories

The increasing complexity of sewage composition, the corresponding intricacy and comprehensiveness of treatment plants, and the necessity for effluents of improved and more uniform character have made the works' laboratory an indispensable adjunct of all larger plants. The demand for at least a modicum of laboratory control is extending to plants of a size so small that such control would have been considered quite unnecessary a few years ago. However, much remains to be accomplished in this particular. Missionary effort will require to be expended on city administrators to educate them to the worth of competent operators and to the rewarding value of proper laboratory equipment.

Laboratory Methods and Gadgets

"Standard Methods for the Examination of Water and Sewage," now in its eighth edition (1936), is of course the vade mecum of the laboratory worker. New sorts of tests are being developed for specific conditions. In particular, more rapid methods giving sufficient accuracy, and yet capable of practical and authentic interpretation, are being sought. Some of the recent contributions which have been made to the laboratory art are in terms of equipment and some in terms of method.

The importance of proper sampling has, of course, long been recognized. At Munich, Keppner has devised a sack-sampler. Composite samples collected with this sampler contain 17 per cent more settleable solids than do similar samples taken with the ordinary form of metal collector. A sludge sampler consisting of a piece of pipe of the required length with a detachable return bend, forming a "U" at one end, has recently been suggested as a satisfactory device for collecting sludge at any desired depth. The open side of the return bend is provided with a stopper which is withdrawn by the connecting chain or wire when the "U" has been lowered to the required elevation in the sludge. Sludge rises in the pipe extension to the static water level. As the pipe is withdrawn (raised) it discharges continuously thus preventing the ingress of sludge from higher levels. The utilizable sample is contained in the U-tube which is readily detached.

Methods of measurement of the intensity and concentration of odors in sewage and water have been improved recently by Fair, Baylis and others.

Setter at the New Jersey Agricultural Experiment Station has conducted experiments to determine the availability and accuracy of the centrifuge for the rapid determination of suspended solids in activated sludge. The procedure requires but a few minutes and is reported to be satisfactory in comparison with the standard Gooch crucible method. When applied to crude sewage the percentage of error was greater. What is believed to have been a somewhat similar procedure had been previously used by Donaldson and thereafter by Vermilye at Tenafly. The test as a control measure has been reported by Andersen to be of decided value at Rockville Center, L. I.

Nearing Completion Is One of America's Most Important Large Plants—Washington, D. C. Separate Sludge Digestors; Mechanical Sludge Dewatering; 1,000 *H.P. Gas Engines; Capacity* 130 *M. G. D.*

G. W. Holmes at Syracuse has recently conducted experiments with a "Transometer," so-called, utilizing an electronic cell for the determination of suspended solids in sewage. The principle involved is that of light absorption by sewage through a fixed distance. The average error in comparison with the Gooch crucible method is stated to be 9 per cent, a value which Holmes believes to be within the limits of error of the standard method of determination.

Nordell has developed an instrument which he calls the "Odeeometer" by which in one hour's time it is said that a complete test can be made. This test purports to determine the condition or activity of activated sludge and to evaluate the sewage load upon a plant comparable to the time consuming bio-chemical oxygen demand test. To the rate of utilization of oxygen, in parts per million per hour, by sewage and sewage sludge mixtures Kessler and Nichols have given the designation of "Nordell Number."

Operator Training and Licensing

Because stream conditions are becoming such as to compel public authorities to be more exacting with respect to the character of sewage effluents, and because sewage treatment has become in many cases an intricate and sensitive procedure, the operation of treatment plants is often a highly technical and specialized matter which demands aptitude, training and experience on the part of those in charge. Politics cannot safely be mixed with education; nor with water; nor with sewage. Where this fundamental thesis is recognized and administrators are also wise in other respects, trained and capable men have been appointed to operate the larger and some of the smaller works in this country. However, for the operation of small plants, in general, it appears that the best that can be hoped for is that operators shall be obtained from the skilled labor group and perhaps still more frequently from among intelligent unskilled laborers. These men, starting "from scratch," must somehow or other be made acquainted with their problems and be given such training as will enable them to carry on with reasonable skill and efficiency.

The existing situation is all too frequently not commendable. It is surprising, however, to find that plants are being made to function as well as they sometimes do when one considers the background and lack of training of operators in charge.

Good operation is frequently an economic enterprise. An alert, capable superintendent can find many ways to save money or to obtain better results with a seemingly inadequate budget. Competent operating records are valuable for future reference, for the general improvement of the art, and for the morale of the operators themselves. Good operation implies good records.

Conventions of sewage works associations, where papers are presented and an opportunity for the discussion of problems is afforded, are extremely useful. Among other good things that they accomplish they encourage esprit de corps. Unfortunately, however, the operators of the smaller plants, who most need these advantages, for the most part are not given the opportunity to enjoy them because the community administrators do not appreciate their value sufficiently to furnish the necessary travel allowances. Lamentably, the rate of pay of such operators is too low to permit them to afford the cost of attendance out of their own pockets.

Reynolds has recently (1935) made a survey of so-called short schools for operators of water and sewage works and of each group by itself, which have been conducted at various times and places in the United States. He found that in five states such schools have been conducted from time to time for sewage works operators alone and that in seven other states schools have been held for operators of both water and sewage works. The consensus of opinion among those who have observed results from such schools is that they have been responsible for a definite improvement in the operation of plants in charge of those who attended. Such improvement embraced the installation of laboratory equipment, the making of tests and the keeping of better records.

A discussion of this matter at the Seventh Spring Conference of the California Sewage Works Association in 1935 brought out the suggestion that if Mahomet could not go to the Mountain, the Mountain might be carried to Mahomet in the shape of a peripatetic laboratory which would move from place to place, spending sufficient time at each to meet the needs of that particular locality or district and its personnel. This seems to be a most worthy suggestion and one which at the moment has a greater chance of success than does the short school—that is, unless more general attendance thereat can be had than has been the rule in the past; and, unless more individual attention can be given to those who do attend.

The pamphlets giving instruction in sewage works operation which have been prepared by some State Sanitary Engineering Bureaus are undoubtedly serving a useful purpose and are instrumental in bringing about an improvement in the operation of the smaller plants. Congratulations are to be extended to the Division of Sanitary Engineering of the Illinois State Department of Public Health upon its occasional bulletin known as "The Digester," which it issues "to promote the installation and efficient, economical operation of sewerage systems." The several issues of this well prepared mimeographed bulletin have been replete with helpful suggestions for operators.

Licensing

If licensing could mean that every sewage works operator were competent to perform his job, then all who stand for the best interests of sewage treatment would probably vote in its favor. Ultimately it is to be hoped that through adequate training, experience and examination in the practical operating requirements of their respective types of plants, all operators may be licensed. In some states it will be a long time before this result can be achieved. A necessary prerequisite will be the education of the general public in respect to the value and expediencey of licensing.

Some states already have a system of licensing sewage works operators—notably New Jersey and Michigan. Only recently did notice of a competition examination of applicants for the position as Supt. of Sewage Treatment in a Michigan city require that the applicant meet the requirements of the Michigan Operators' Licensing Act as a First Class Sewage Works Operator.

The licensing of sewage treatment plant operators, if permitted to be administered honestly and wisely, should result in improving the salary as well as the security of the licensees.

A procedure of voluntary certification of California sewage plant operators has just been instituted under the auspices of the California Sewage Works Association. Applicants are being classified into three grades.

"Score Cards" for Treatment Works

It is believed that the scoring of treatment plants, especially if compulsory and general, and the giving of

publicity to the ratings, would improve the quality of operations and the resulting effluents from all classes of works. Officials of Toonerville will likely not sit complacently by and see Hootstowns' rating soaring above their own. A primary requirement will be, of course, that even the simplest type of plant yielding only a partially treated effluent can obtain a perfect score if that type of plant and degree of treatment meet the needs and if the operation is carried on as well as it should be.

The New York State Sewage Works Association has already wisely adopted the scheme which is operated by a Rating Committee which studies operating reports and evaluates plant operation. Its first award was made to the Rockville Center (L. I.) plant at the 1936 Spring meeting. To operator George C. Andersen went first prize for the best set of operating records examined by the committee.

If some way could be found whereby all plants would be compulsorily rated (and the rating made public) the desired effect would undoubtedly be brought about much more quickly.

Through the California Sewage Works Assn. for several years an Award of Merit (a medal established by Wallace and Tiernan Co.) has been presented annually to that plant adjudged by a standing association committee to be most worthy by reason of efficient and enterprising operation. The scheme has undoubtedly contributed to better efforts and certain plant improvements. In addition to the medal award honorable mention has usually been given to one or more specially deserving applicant plants.

Gadget Displays

The Ninth Annual Ohio Conference on Sewage Treatment in October, 1935, held its first gadget exhibit in which fourteen interesting devices were entered. These gadgets exhibited showed that many operators were "on their toes" and had original ideas and ingenuity. Three awards of prizes were made to stimulate interest. It is to be hoped that the idea will spread and that gadget displays will become a feature of at least one meeting per year of each of the sewage works associations. It is reported that in 1936 three other associations adopted the scheme which will be repeated each year.

[The second and concluding part of Professor Hyde's review deals with advances in Sewage Treatment Practices, Sludge Disposal, Pollution Control and Required Degrees of Treatment. It will appear in our next issue, the necessity of which we regret.—EDITOR.]

▼

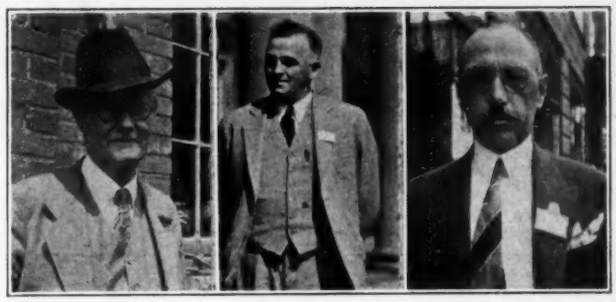
1937 Honors and Awards Announced by A.W.W.A.

Following its annual meeting held June 20th, the Board of Direction of A.W.W.A. through H. E. Jordan, Executive Secretary, has announced the following honors and awards voted for 1937. The four Honorary Memberships and the two awards are to be presented, as customary, at the annual dinner which rings down the curtain on the 1937 Convention at Buffalo on June 12th.

Honorary Members

*Thomas Brooks, Sup't., of Distribution, Bureau of Water, Los Angeles, Calif. (Member since 1925.)

William W. Brush, Editor, Water Works Engineering, New York City, N. Y. (Member since 1911 and a past-president.)



W. M. Rapp, Atlanta, Ga. *R. L. Dobbin Peterboro, Ont.* *W. W. Brush, New York City*

Ross L. Dobbin, General Manager, Utilities Comm., Petersborough, Ont. (Member since 1923 and a past-president.)

William M. Rapp, Sup't. Constr. and Distrib. Water Dep't., Atlanta, Ga. (Member since 1899.)

(*To Mr. Brooks, our apologies. A picture of him was not available at the time of going to press.—Ed.)

Awards

To Abel Wolman will go the highest award of the association—the John M. Diven Memorial Medal. The award is made "to that member who has rendered an outstanding service to the association." Mr. Wolman, who is retiring as Editor of the Journal of A.W.W.A., was cited, not for one service, but for his many invaluable services to the association. Among these most emphasized were his 16-year service as Editor of A.W.W.A.; his representation in behalf of A.W.W.A. in Congressional and Committee Hearings in Washington and as Chairman of the National Committee on Water Resources; for his gift of presentation of topics and analysis of problems concerning A.W.W.A., he was further cited.

Abel Wolman *Laurence E. Goit*

To Messrs. L. E. Goit and Harry Hayes, Engineers of the Bureau of Water, Los Angeles, was voted the John M. Goodell Prize—"for the most notable contribution to the science or practice of water works development" during the year. These members were cited for their joint contributions toward the development and application of improved bituminous pipe coatings. Their interlocking papers, presented before the 1936 Convention in Los Angeles—"Laboratory Control of Protective Treatment of Steel Pipe" and "The Steel Pipe Cleaning and Coating Plant of the Los Angeles Bureau of Water Supply"—have been published in the September, 1936, A.W.W.A. Journal.

HOW MUCH WATER DO WE CONSUME —WHAT DO WE PAY FOR IT?

By CHARLES H. CAPEN, Jr.*

This article is the 6th of a series by Mr. Capen which have been running during the past two years in WATER WORKS AND SEWERAGE.

Acknowledgment is made of the fact that this paper, by mutual agreement, was presented by the author before the N. Y. Section of A. W. W. A. December 29th, 1936. Therewith, this paper became the property of the association and is being here reproduced by agreement. Simultaneously, in the current issue of the A. W. W. A. Journal it also appears.

Other articles by Mr. Capen on the subject of consumption, water utility finances, and fire protection charges, are to be found in WATER WORKS AND SEWERAGE *for February,* 1934; *September,* 1934; *August,* 1935; *February,* 1936; *September,* 1936. *This article concludes the series. But not we hope, contributions by the author to future issues of this magazine.—Ed.*

QUESTIONS as to volume and cost of water consumed are not easily answered. Very few waterworks men can give more than a very general answer to the question propounded in the caption to this paper.

Rule of thumb methods, while very useful in the early days of water supply development, are gradually giving away to established facts. One of the oldest rules was that a water supply should be designed on a basis of 100 gallons consumption per capita per day. Voluminous data have been published on the subject but the facts have not always been assembled in such a way as to permit the drawing of definite conclusions. The following discussion will serve to throw some light on the matter of per capita consumption of water, together with the relationship between consumption, revenue and population.

Population vs. Consumption

It is fairly well established that as a city grows in size, the per capita rate of consumption increases. There are several reasons for this, among which are: greater industrial use, the presence of many visitors and commuting workers who are not counted as residents in census counts, increase in demands for street washing and sewer flushing and other municipal uses. Such an increase starts off fairly slowly with small residential communities, increases at a more rapid rate as the characteristics change to those of a city, and finally tends to reach fairly static trend level.

Data Available

To aid in establishing the general trend of increase that may be expected, various reports of water consumption have been examined. Probably the most comprehensive contribution in recent years is that published by the American Water Works Association[1]. In fact the information presented is so voluminous as to be almost overwhelming and it includes so many minor supplies that a complete study of it would not only be tedious but seems unnecessary. The more recent compilation by Rudd and Michael[2] presents a much less impressive but apparently a more reliable tabulation. It also contains figures on revenue, thereby permitting a study of the correlation of revenue with consumption and the relationship of both to numbers of consumers and populations.

In addition to the tables noted, the writer has had access to copies of annual reports of all water supplies in New Jersey made to the Board of Public Utility Commissioners and the annual reports of the State Department of Health, whereby a fairly accurate comparison involving a large number of supplies was possible.

Use of Data

Taking the tables of the A. W. W. A.[1], the per capita consumption has been computed for all supplies delivering water to more than 10,000 people. However, only those supplies for which the estimated populations supplied were definitely listed were included in the study. This was done for filtration plants and simple chlorination plants, both groups being further subdivided into municipal and private supplies. For each of these four classes, summaries were prepared, grouping the average results in relation to population as shown in Table 1. These figures are for the year 1930 and may be expected to be somewhat higher than for subsequent years.

The A. W. W. A. booklet states that the average per capita consumption in the United States in 1930 was 132 gallons per day. This is a weighted average obtained by dividing the total water consumption listed by the total population represented. Although the statement is probably correct, it does not provide a picture which takes into account variations of consumption with population.

The results of Table 1 are distinctly irregular and do not permit very definite conclusions pertaining to per capita consumption. From a careful analysis of the data assembled in preparation of Table 1, it appears that several individual (extreme) cases of supplies in certain industrial centers far outweigh the general average and give distorted results. For example, there are several cases of per capita rates from 200 to nearly 700 gallons per day. In almost every one of these cases, the name of the municipality involved brings to mind some large industry which without doubt takes a vast amount of water. An example is the privately owned system at Anaconda, Montana, where the per capita rate is 422 gallons per day. The population served is only 12,529 and the effect of this one figure raises the average per capita rate in that class by 14 gallons per day.

Rudd and Michael have canvassed more than fifty supplies, giving a fairly representative cross section of the entire United States for the year 1932. For these: "Gallons per Capita per Day"; "Revenue per Capita per

*Engineer, North Jersey District Water Supply Commission, Newark, New Jersey.

TABLE 1.—WATER CONSUMPTION IN THE UNITED STATES IN 1930.
AVERAGE GALLONS PER CAPITA PER DAY.

Population Range	Filtration Plants				Simple Chlorination Plants			
	Publicly Owned		Privately Owned		Publicly Owned		Privately Owned	
	Gals./Capita	Supplies	Gals./Capita	Supplies	Gals./Capita	Supplies	Gals./Capita	Supplies
10,000 to 20,000	132	93	112	55	159	40	134	22
20,000 to 50,000	113	75	104	35	150	23	126	17
50,000 to 100,000	137	25	101	16	130	16	122	5
100,000 to 200,000	122	17	81	4	106	5	68	2
200,000 to 500,000	116	13	102	3	116	4	163	2
500,000 to 1,000,000	159	5	86	1	...	..	...	..
Above 1,000,000	148	3	...	..	209	3	...	..

TABLE 2—WATER CONSUMPTION AND REVENUE FOR 52 CITIES IN THE UNITED STATES AND CANADA IN 1932

Population Ranges	Average Consumption Gallons Per Capita Per Day	Average Revenue—Dollars Per Million Gals.	Average Revenue—Dollars Per Capita	Average Population	Number of Supplies
20,000 to 50,000	85	$187	$5.38	33,000	7
50,000 to 100,000	103	150	5.15	64,000	10
100,000 to 200,000*	107	135	5.14	135,000	10
200,000 to 500,000	110	116	4.38	325,000	14
500,000 to 1,000,000	138	93	4.51	873,000	5
Above 1,000,000	167	74	3.87	3,034,000	5

*One city in this range, obviously out of line, has been omitted from the computations. With that city included the figures from left to right become—118; $130; $5.14; 132,000; 11.

Year"; "Revenue per Million Gallons" were computed. Using these values as ordinates, together with population, points were plotted for the various combinations possible with the four variables, on regular, arith-log and log paper; and, in one case, a series was arranged and plotted on arithmethic probability paper. None of these charts are presented because they are not sufficiently conclusive, in the main, to permit more than a general interpretation of the trends. In their place, summaries were made by grouping the average results according to populations. The result is presented in Table 2. (An investigation by the writer showed that some of the figures reported by Rudd and Michael[2] have since been revised. Table 2 includes the revision.)

This table, based on carefully checked data from representative cities in about half of the states in the Union and two Canadian provinces, deserves much greater consideration than Table 1. The consumption figures—"Gallons per Capita per Day"—show a very definite increase with an increase in population. With the omission of one case (obviously out of line) the increase is surprisingly uniform. The revenue—"Dollars per Million Gallons"—also shows a very definite trend. It is apparent, also, that quantity production permits lower prices per unit for water as is true of other commodities. Revenue figures in "Dollars per Capita" tend to show a somewhat lower rate as population increases, but the irregularity leads to the conclusion that greater industrial, commuter and municipal uses largely off-set the reduction that might otherwise be expected with an increase in population. The figures obtained lie between those given by Metcalf[3] for 1923 and the $6.00 per capita revenue cited by Howson[4] in 1933. It seems probable that if individual water bills for domestic service could be carefully examined, the dollar per capita revenue would follow a course similar to that of the dollar revenue per million gallons.

As a comparison and check, similar data for 1932 were taken for all supplies in New Jersey involving more than 1,000 population. (Supplies greatly influenced by summer population—mostly seaside places—were not included for obvious reasons.) Points were plotted as before, but again the results did not permit drawing accurate curves and have therefore been omitted. However, Table 3 shows the result of a tabulation of averages similar to Tables 1 and 2, except that the range of population is from 1,000 to 500,000 instead of the higher population values used in the preceding tables. An important point that was taken into consideration in making Table 3 was that where one supply serves a number of different municipalities, the type and location of these municipalities was studied and in most cases an average population was used rather than the total. As an example, the case most extreme showed one supply serving over 400,000 people scattered throughout more than fifty municipalities, ranging from very small suburban communities to fairly large industrial cities. It would be obviously erroneous to assume that the entire population so served should be considered as one large city having the total population indicated.

As a general comment on the results given in Table 3, it must be pointed out that considerable weight may be given to the figures for revenue and quantity of water because of the requirements of the various New Jersey

TABLE 3—WATER CONSUMPTION AND REVENUE FOR 113 SUPPLIES IN NEW JERSEY FOR 1932

Population Range	Average Consumption Gallons Per Capita Per Day			Average Revenue Per Million Gallons, Dollars			Average Revenue Per Capita Dollars			Number of Supplies		
	City	Private	Avg.	City	Private	Avg.	City	Private	Avg.	City	Private	Total
1,000 to 2,000	54	61	56	$336	$316	$330	$6.00	$6.20	$6.07	17	6	24
2,000 to 5,000	73	70	72	271	271	271	5.88	6.56	6.10	19	8	27
5,000 to 10,000	77	70	75	244	317	264	6.01	6.67	6.23	17	8	24
10,000 to 20,000	85	73	81	210	295	239	5.42	7.26	6.00	11	4	16
20,000 to 50,000	90	83	89	175	294	190	5.47	8.88	5.70	7	1	8
50,000 to 100,000	89	..	100*	195	...	160*	6.31	...	5.50*	2	..	2
100,000 to 200,000	130	..	130	114	...	114	5.47	...	5.47	2	..	3
200,000 to 500,000	113	..	113	107	...	107	4.30	...	4.30	2	..	3

*Revised estimate—see text.

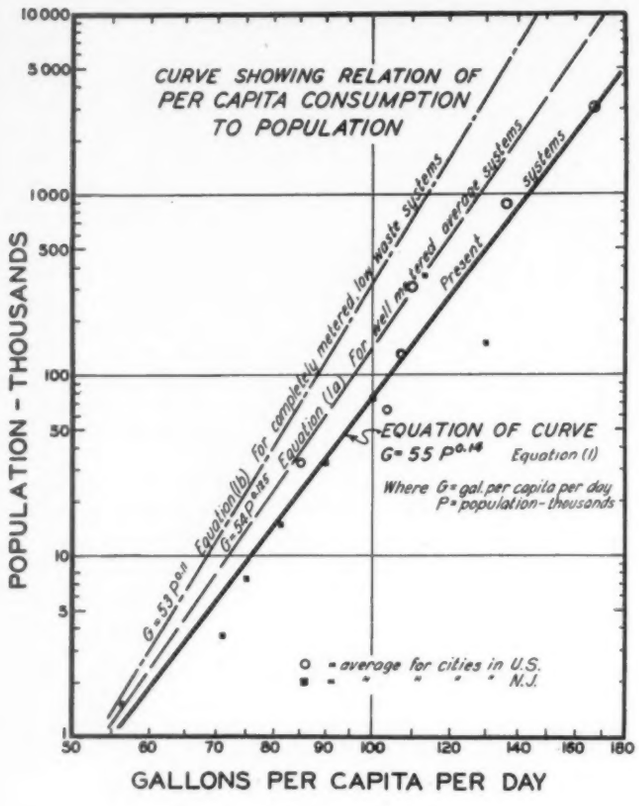

CURVE SHOWING RELATION OF
PER CAPITA CONSUMPTION
TO POPULATION
Equation (1b) for completely metered low height systems
Equation (1a) For well metered average systems
Present systems
EQUATION OF CURVE
G = 55 P^0.14 Equation (1)
Where G = gal per capita per day
P = population - thousands
o = average for cities in U.S.
■ = " " " " N.J.
POPULATION - THOUSANDS
GALLONS PER CAPITA PER DAY

FIGURE 1

regulatory and health authorities with regard to reporting accurately. The excess water diversion tax in particular has a strong influence on obtaining reliable water consumption data. Only in the matter of population served is there apt to be any element of unusual variation in estimates. This last condition, however, holds true in all parts of the country.

In the preparation of Table 3, it was noted that the computed figures for municipalities in the population range of 50,000 to 100,000 were rather abnormal. There were two supplies in this class, both of which operate under certain peculiar conditions that probably do not exist in any other part of the United States. The writer therefore has made some estimates to counteract the conditions and has presented not only the actual figures but also corrected values.

It may be also observed in Table 3 that the per capita rate in the 100,000 to 200,000 population class is out of line and is greater than in the next higher population class. This situation has been studied and the cause may be almost wholly attributed to incomplete metering and large specific industrial usage.

Trend Curves

With figures taken from Tables 2 and 3, points were plotted on logarithmic paper for daily consumption per capita and dollar revenue per million gallons, individually compared with population. The results are shown in Figures 1 and 2 respectively. In each case the plotted points have been designated by shape so as to indicate from which data table they have been taken. For all practical purposes, however, it may be said that Tables 2 and 3 are in reasonable agreement as these graphs indicate.

In addition on Figure 1, there have been added two secondary curves. One represents the average consumption to be expected with a fairly high per cent of metering plus waste elimination; the other represents probable consumption with *complete* metering and *stringent* waste regulation control. No corresponding curves have been drawn on Figure 2 because a reduction in consumption following metering and waste elimination is not followed by a proportionate reduction in revenue. To estimate the final outcome would involve a separate study that would have no place in the present discussion. [These curves give, in general, substantially higher rates of per capita consumption than those presented by Metcalf[5], who based his findings largely on meter-rates.]

It seems reasonable that pressure carried on the mains should have an important bearing. In the general effort by water utilities to obtain fire flows desired by fire underwriters, the effect of the increase in pressure on per capita consumption does not appear to have been given its proper consideration. Rainfall, temperature and geological features probably all have an influence but this is apt to be less than might be generally supposed.

Equations for the two curves have been determined and are shown in simplified (approximate) form on the graphs. Assuming that the revenue received and total water used in each community have been reported in a reasonably correct manner, it follows that the revenue curve is the more reliable of the two because it involves only one uncertain ordinate, i e. population. Conversely, the per capita consumption curve, involving population in both ordinates, is admittedly less dependable. The range of both revenue per million gallons and per capita consumption is sufficiently great to permit construction of curves on reasonably spaced ordinates.

No curve has been drawn for revenue per capita per year in relation to population. The reasons are that not only would there be the uncertainty of population estimates involved in each ordinate, but the variation between maximum and minimum is not sufficient to permit construction of a reasonable curve. The equations for curves 1 and 2, however, immediately suggest a method

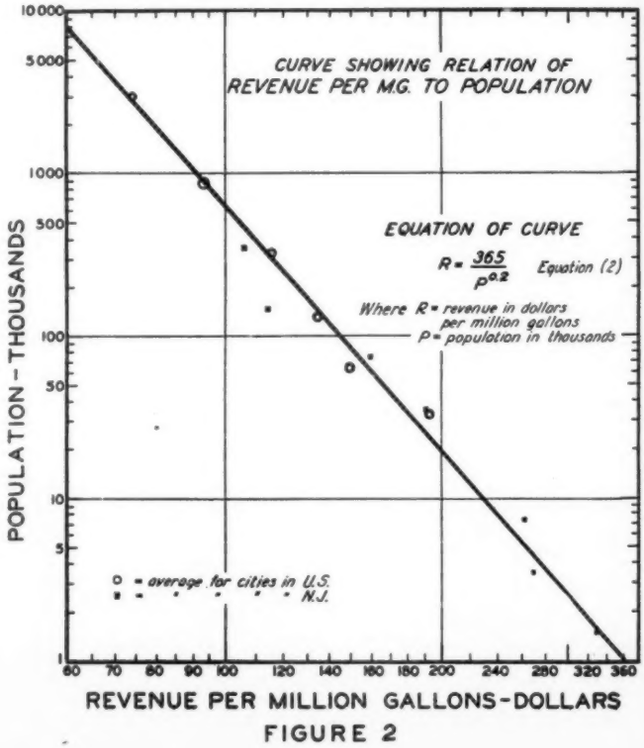

CURVE SHOWING RELATION OF
REVENUE PER M.G. TO POPULATION
EQUATION OF CURVE
R = 365 / P^0.2 Equation (2)
Where R = revenue in dollars per million gallons
P = population in thousands
o = average for cities in U.S.
■ = " " " " N.J.
POPULATION - THOUSANDS
REVENUE PER MILLION GALLONS - DOLLARS

FIGURE 2

TABLE 4—REVENUE PER CAPITA IN RELATION TO POPULATION

Population	Revenue Per Capita Per Year—Equation-3 (Highest)	Equation-3a (Average)	Equation-3b (Lowest)
1,000	$7.30	$7.20	$7.05
10,000	6.35	6.05	5.75
100,000	5.55	5.10	4.65
1,000,000	4.80	4.30	3.80

TABLE 5—METERS AND BUSINESS CONDITIONS IN RELATION TO PER CAPITA CONSUMPTION AND REVENUE, NEWARK, N. J.

Year	Population	Per Cent Services Metered	Gallons Per Day Per Capita	Per M. G. Revenue	Per Capita Revenue
1910	347,469				
1914		58.8	119	$ 82	$3.60
1915	366,721*	60.6	114	81	3.45
1916		64.8	123	84	3.85
1917		88.1	116	85	3.65
1918		89.9	113	85	3.70
1919		90.7	104	89	3.55
1920	414,524	92.2	109	89	3.75
1921		92.7	96	93	3.50
1922		93.9	101	91	3.60
1923		94.3	106	90	3.75
1924		95.2	105	90	3.80
1925		95.3	105	91	3.90
1926		95.6	106	92	4.15
1927		95.6	105	92	4.10
1928		97.0	108	92	4.20
1929		96.8	114	93	4.40
1930	442.337	96.8	111	93	4.30
1931		97.2	103	99	4.15
1932		97.6	94	97	3.90
1933		97.0	91	102†	3.95†
1934		97.0	101	105	4.55
1935		98.1	101	105	4.55

*State census. All other populations are from Federal Census. Intermediate populations are not shown as they differ slightly from Newark Water Department estimates. Per capita rates are correspondingly affected.

†Rates increased by a 15% surcharge in October 1933.

for a theoretical determination. Multiplying the equation for population—consumption curve (Fig. 1)—by the proper constant converts it into an equation giving million gallons per capita per year. Then multiplying this revised equation by that for population—revenue (Fig. 2)—gives the revenue per capita per year. The result obtained is approximately the following:

$$\text{(Equation 3)} \quad R = \frac{7.3}{P^{0.06}}$$

In which, R = revenue in dollars per capita per year.
P = population in thousands (the three ciphers dropped).

Similarly from Equations (1a and 1b), see Fig. 1, the following are obtained.

$$\text{(Equation 3a)} \quad R = \frac{7.2}{P^{0.073}}$$

$$\text{(Equation 3b)} \quad R = \frac{7.05}{P^{0.09}}$$

From these new equations, Table 4 can be made. Naturally the figures therein cannot be expected to check the widely varying results in Tables 2 and 3 for similar items and population classes. In reviewing some of these differences it was found that whereas arithmetic averages were used throughout, weighted averages tended to give results in Tables 2 and 3 that were in closer agreement with Table 4. It is believed therefore that Equation (3a) and its corresponding values in Table 4 may be considered fairly indicative of average conditions.

Effect of Meters and Economic Conditions

Conclusions as to the significance of this study would not be complete without a few comments as to the effects of meters and business conditions. Table 5, revealing in the case of Newark, N. J., the per cent of services metered together with other variables here discussed, shows both metering and business effects very clearly.

The decrease in per capita use as the result of meter installations, even during the war period, is quite evident. Likewise, is the effect of the business slump in 1921. Then came the recovery effect during the next few years which culminated in the 1929 peak. The history of the next few years of hard times and closed factories requires no explanation. Needless to say, the whole table is a marked exhibit of the value of metering for the reduction of consumption—more properly, the reduction of water-waste.

Summary

No attempt has been made to go into detailed comparison between supplies that are pumped and those that are not, or to consider individual classes of industries, territory served, pressure, per cent of services metered, condition of distribution system, quality of the water served or nature of supply. These and many other features might be studied in some detail but the value of such differentiation would be doubtful in a general discussion of this kind. They might, however, be useful in comparisons of individual supplies with others of a similar type. [The writer knows of one case in which a city made a detailed study of rates by comparing its rates with those of others having a similar type of supply and population, with the result that the water department was able to show that its much needed increase in rates was well justified.]

Allowance must be made for the fact that the figures given in the presentation and analysis cover only the years 1930 and 1932, the curves being drafted from the 1932 data alone. In 1930 the impetus of the boom period continued so far as water consumption and revenue were concerned. On the whole both were about equal to those existing in 1929. In 1932, water consumption had dropped about 12 per cent below the 1929 level but this was probably less than 10 per cent below a normal or median level. Because this loss of consumption was largely from curtailed industrial usage (low priced water) gross revenue dropped off by only about 6 per cent of the peak of 1929. That was only about 4 per cent below normal gross revenue. The reduction in output (sales) of low priced industrial water resulted in an increased revenue per million gallons which was about 4 per cent above normal.

The low ebb of water consumption during the depression occurred early in 1933 and a definite upward trend (in keeping with stock-market business barometric curves) started in October of that year. Consumption records since that time, also in keeping with the market curves, reflect very definitely a generally rising course. However, the rise has been tempered by the very effective drive on water waste instituted by many water departments, started under the stress of recent times, and being continued as economy measures to curtail all reasonably reducible losses. The late depression taught business, utilities and even municipalities much concerning economies. In some instances partially metered supplies have been reducing consumption by adding more meters, since the hard hit municipalities are now more able to get along without taking needed funds from the water department.

All of these factors have been taken into considera-

tion and it is believed that Equations (1a) and (3a) are indicative of average conditions, in respect to per capita consumption and revenue per capita, to be expected now and for a reasonable time in the future. Equation (2) for revenue per million gallons, however, may give results that are slightly too high in future trends. This conclusion seems to be substantiated by a tabulation made (not reproduced here) of the water output and revenue of about thirty supplies for the years 1928 to 1935 inclusive, wherein the trends of both these items are fairly well demonstrated. [In his conclusions the author seemingly ignores what may be a highly important factor in future trend curves for per capita consumption. Air conditioning, and its future effect on such trend curves, will likely prove of some importance. —Ed.]

One of the best discussions of per capita consumption has been given by Whitman[6] who has aptly said that "the water consumption of each individual place is a problem all to itself." [In making this statement, before the advent of popularized air-conditioning, Major Whitman proved to be a prophet as well as a wise man.—Ed.] The writer has no intention of trying to dispute this obviously true statement. It is believed, however, that there has been demonstrated through the studies here reported that a definite general relation between the various main factors discussed does exist and can be utilized to advantage.

In conclusion, it can be said that as population increases, per capita consumption increases. Coincidently revenue per million gallons and revenue per capita per year decrease. For any given supply, where marked deviations from the curves occur, the explanations may generally be found in one or more unsual conditions which exist in that particular case.

The curves are presented, therefore, in the hope that water works men may use them to advantage in comparing their individual problems with average conditions and may thereby be guided in their policies concerning their own supplies.

BIBLIOGRAPHY

[1]American Water Works Assoc. (1933) Census of Municipal Water Purification Plants in the U. S.—1930-31."
[2]Rudd, Wm. C., and Michael, Arthur C. "Income and Operating Costs." Jour. A. W. W. A. 26, 6; June, 1934.
[3]Metcalf, L. "The Financial Status of Water Works in the United States as of January 1, 1924." Jour. A. W. W. A. 13, 4; April, 1925.
[4]Howson, L. R. "Water Rates and Construction Policies in Municipally Owned Plants." Jour. A. W. W. A. 25, 1; January, 1933.
[5]Metcalf, L. "Effect of Water Rates and Growth in Population upon Per Capita Consumption." Jour. A. W. W. A. 15, 1; January, 1926.
[6]Whitman, E. B. "Per Capita Consumption." Jour. A. W. W. A. 24, 4; April, 1932.

▼

Up-State New York Sewage Works Operators Organize

Under the leadership of Arthur Cary, Superintendent of Public Works at Fairport, N. Y., sewage works managers and operators and sanitary engineers and chemists, in the Rochester district, met in Fairport to organize the Up-State Section of the New York Sewage Works Association. The group decided to hold periodic meetings in municipalities comprising a circuit covering the seven counties represented. As chairman, Mr. Cary was elected; as Secretary, E. A. Marshall, Superintendent of Treatment Works at Geneva.

The new Up-State Section is the second regional organization to be established under sponsorship of the N. Y. State Association.

"DRY CLEANING" AIR DIFFUSER PLATES

By A. M. RAWN*

Los Angeles, Calif.

Every once in a while someone does something that makes one stop and wonder why it has never been done before. Or, if ever done, why he has not heard of it.

Maybe you have been in Southern California when, due to "unusual weather conditions" the winter temperature drops below freezing and the citrus growers start the orchard smudge-pots, to warm up the whole outdoors and keep the crops from freezing. If you have, you may recollect that upon such occasions the air in the orchard areas is so filled with thick, oily smoke that one cannot see a hundred feet. This winter has been such a one and for a number of days early this month (January) millions of gallons of oil have been burned in the smudge-pots.

Now this may not seem to have anything to do with sewage disposal, but strangely enough it does have.

The city of Ontario lies right in the heart of the citrus grove area and, in consequence, was encompassed in a dense smoke fog for some time. During this period the operator of the Ontario activated sludge plant noticed that pressure on the air lines was steadily increasing at the blowers. Attributing it to the oily carbon in the air, as most likely responsible for the clogging of the diffuser plates, he made every effort to cleanse the air by straining it through several thicknesses of cloth over the air inlet to the blowers. The cloths were changed frequently but to no avail. And, pressures at the blower mounted from 5 to 7½ pounds over night.

Obviously the diffuser plates, which had operated for more than a year with no building up of pressure, had to be cleaned. The finely divided carbon and oil in the smoke had doubtless spread quite uniformly through the plate pores. The orthodox manner of cleaning would have been to remove the plates and clean them up with a solvent and, if not successful, burn out the volatile materials, possibly. The city engineer had other ideas however, and instead of bringing the plates to the solvent the solvent was taken to the plates. A scheme for injecting the solvent into the air stream from the blowers was put into operation.

What was actually done was to slowly pump "Aviation" grade of gasoline into the air line and beyond the blower. Two gallons of gasoline was fed into the pipe slowly during a 24-hour period. It did the job all right, because during this period pressures dropped back to normal and the trouble was completed cured. So far, there has been no injurious effect upon the quality of the plant effluent or the behavior of the sludge.

This struck the writer as being a most unique method of overcoming a serious difficulty. I thought you might be interested and therefore, am sending on this account of Ontario's experiences in "Dry Cleaning" diffuser plates. Mr. Austin Burt, Ontario's city engineer, was "the brains" behind this "solvent-solved situation"; and H. M. Ely, as chief operator of the plant, was "the brawn."

(*NOTE.—This interesting story is essentially the context of a letter to WATER WORKS AND SEWERAGE from Mr. A. M. Rawn, Assistant Chief Engineer of the Los Angeles County Sanitation Districts, who claimed that "this is one for the book." In this we concurred and, with his kind consent, are printing his account.—Ed.)

THAWING SERVICE PIPES---A REVIEW

By FRANK C. AMSBARY, JR.
Supt., Illinois Water Service Co., Champaign, Ill.

F. C. Amsbary, Jr.

BELIEVING that a review of the experiences and the recommendations of others in connection with pipe and service thawing would be of help to the writer, some time has been spent in reading published articles on this subject and in gathering information from other operators. The information collected has been of interest and value and is presented here for what it may be worth to others.

Electrical thawing seems to be rapidly replacing all other methods. It is fast, and requires a minimum of labor, but must be carefully handled or disaster may result. Because of the increasing popularity of this method, and the dangers present when large currents are used, this review will deal, in the main, with this method.

Two principal sources of energy have been used with success and are here named in the order of their apparent popularity:

1—Gasoline engine driven generator (welder type).

2—Transformers.

The current obtainable from these two sources, in thawing services, is limited only by the requirement of the application.

Operators have experienced the difference in the length of time required to thaw services of different materials, which are of the same diameter, approximately of equal length and under apparently similar conditions. Assuming no gaskets or patent coupling in the line, and all other conditions alike, except material, the reason for one material permitting more rapid thawing than another is shown in Table I which gives the resistance in ohms per milfoot for metals most commonly used in service construction. Bear in mind that because of the difference in the proportioning of various elements used in making pipe, these values will vary. However, this table is accurate enough to serve as a guide.

TABLE 1

Metal	Ohms per milfoot*
Copper	9.35
Steel	63.00
Wrought iron	82.80
Lead	123.00
Cast iron	684.00

*Resistance in piece of metal .001 inch in diameter 1 foot long.

It is felt that these figures should be kept in mind as an aid to the operator thawing services. For example, assume a wrought iron service is to be thawed, tapped onto a cast iron main through a lead gooseneck. The higher the resistance per milfoot, the quicker the material will heat up, at any definite rate of current flow. In this hypothetical case, by reference to Table I, the cast iron will heat first, the lead gooseneck next, and the frozen wrought iron last. Lead melts at 327° C. Wrought iron and cast iron at approximately the same point, in neighborhood of 1500° C. If care is not taken the lead gooseneck will melt. This is not only possible, but has happened many times.

Interpreting this table in another way, to thaw out a service of each of these materials under absolutely the same conditions in the same length of time, a minimum current would be required in cast iron and maximum current in copper.

From Water Works Engineering (May 30, 1934) Table 2 is being reproduced because it clearly shows the current needed to thaw services of wrought iron, steel and lead, compared with copper, in a period of, from 5 to 10 minutes.

TABLE 2

Size	Wrought Iron, Steel and Lead	Copper
½"	200 amps	500 amps
¾"	250 amps	625 amps
1"	300 amps	750 amps
1¼"	450 amps	1,000 amps
1½"	600 amps	1,500 amps
2"	800 amps	2,000 amps

The author does not state how these results were obtained. It is the experience of this writer that the smallest current compatible with expedience, is preferred, and if the current is not held down, damage to the water system and even to homes, may result.

The article in question states that, theoretically, "On smaller flows of current, the period of time required is inversely proportional to the square of the current. For example, with ½ inch service . . ., if it takes 200 amperes 10 minutes to thaw out . . ., at 100 amperes it would take 40 minutes."

What Amperage Should Be Used?

The question arises, what rate should be used in thawing a service. A definite answer to this question cannot be given. However, as a guide, various statements can be made from the writer's experience that may be of value. Services have been thawed in a reasonable length of time using 200 amperes at 30 volts on wrought iron and steel, and at 400 amperes on copper. Because of the low melting point of lead, and its relatively high resistance, hence quicker heating, the Hobart Brothers Company, manufacturers of electric welders, recommend a maximum current of 150 amperes with as low as 75 amperes preferred. This low rate of current would require a long time to accomplish the job, but the length of time required is compensated for by assuring no damage to the lead.

The proper size of lead wires from generator to pipe lines, given in Table 3, is reproduced from the article cited, because of the importance of this matter.

TABLE 3

Wire Size B&S	Safe Current Carrying Capacity
0	200 amps*
00	225 amps
000	275 amps
0000	325 amps

*For short periods of thawing, twice these current flows may be employed.

Our First Electric Thawing Machine, 1918. *An Old Metz Automobile Salvaged from the Junk Yard, Plus a Generator Borrowed from the City of Chicago. Following the Emergency We Purchased a 200 Amp—30 Volt Generator and Returned Chicago's. This* 1918 *"Model T" Served Until* 1929.

Time Required

Every operator has been asked "What length of time is required to thaw a service?"

The length of time required is dependent upon the current available, the efficiency of the circuit, and the underground conditions peculiar to any specific installation. The heat generated by the flow of current through the pipe is dissipated by conduction to the surrounding soil, melting the ice and warming the water in the pipe. It would be impossible to predict, for example, the heat conductivity of the soil, or the efficiency of the circuit. The presence or absence of, for example, sand, cinders, clay, gravel, or boulders, all of which have a direct effect upon the heat conductivity of the soil. One man reported the difficulty encountered in a case where a boulder was in direct contact with the service pipe. The capacity of the boulder to absorb the heat generated, delayed the process of thawing.

The Engesser Electric Manufacturing Company, Inc., of Watertown, New York, offers Table 4 as a guide on the approximate length of time required to thaw service pipes.

TABLE 4

Size, In.	Material	Length, Ft.	Volts	Amperes	Time
¾	W. I.	600	60	250	5 minutes
1	W. I.	600	60	300	10 minutes
1½	W. I.	600	60	350	10 minutes
2	W. I.	500	55	400	15 minutes
3	W. I.	400	50	450	20 minutes
4	C. I.	400	50	500	1 hour
6	C. I.	400	50	600	2 hours
8	C. I.	300	40	600	4 hours
¾	Copper	400	40	500	30 minutes
1	Copper	400	40	600	60 minutes
1¼	Copper	300	35	600	60 minutes

Generator Thawing

Gasoline engine driven generators of the welder type are growing in popularity for the thawing of services. At Champaign-Urbana, the writer's father developed the first one in use at that plant in the winter of 1917-18. How long this method had been used before that time, or who the originator was, could not be determined. The advantages of this method over others used, is that it eliminates the necessity of laborious and costly digging of frozen ground, or a specially trained crew to make the primary connections on transformer equipment. The speed with which the welder may be hooked up, thaw the service and get away to the next job is an attractive feature.

To find out the problems encountered, methods used, and policies followed in thawing service pipes, the writer used two sources, the Round Table discussion in the May and June, 1934, Water Works Engineering, and by circularizing a group of operators.

Each of these sources will be reviewed separately, because of the difference in the questions asked and the lapsed time between questionnaires. Table 5 gives a resume of the answers in the Round Table discussion, on methods used and policy followed in allocating costs.

TABLE 5

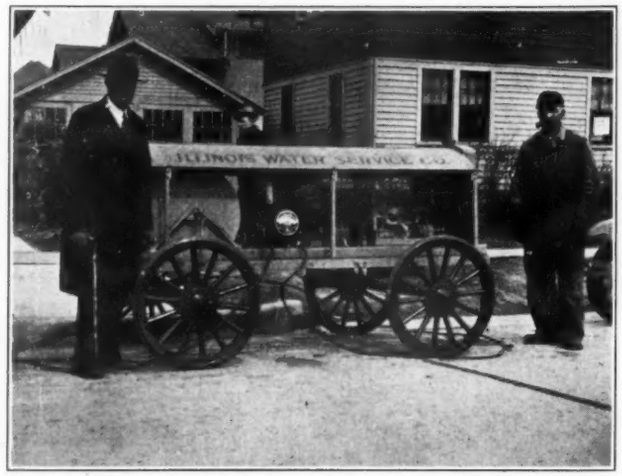
Method of Thawing			
Transformer	19	Consumer pays from curb in only	13
Welder	11	Consumer pays total cost	11
Electricity	9	Water works pays total cost	11
Steam	9	Cost is split	3
Hot water	5		
Hot air	1		
Battery	1		

The persons answering our questionnaire used various methods in replying, which made tabulation rather difficult. However, with the information furnished the tabulation in Tables 7 and 8 is representative. It will be noted that 9 reported electrical thawing, but did not specify the apparatus used.

TABLE 6—COSTS

Transformer	Welder	Electricity	Steam	Hot Water	Not Classified
1—$ 1.45	1—$ 1.65	1—$3.50	1—$ 3.50	1—$ 7.00	2—$ 4.50
2— 2.50	1— 3.50	1— 9.50	1— 50.00 to $60.00	1— 10.00	2— 15.00
1— 2.82	1— 4.77				1— 20.00
1— 3.00	4— 5.00				1— 7.00 to $50.00
1— 3.37	1— 7.00				
1— 5.72	2— 10.00				
1— 5.50	1— 15.00				
1— 6.20					
4— 10.00					
3— 15.00					
1— 20.00					

Table 6 reveals costs and charges. No distinction was made. Some of these figures represent the actual cost, while others represent the charge made to the water works by the person or firm executing the work, or the charge made by the water works, or third party, to the consumer.



Evolution—or What Happened in 1929 *to Our "Model T." With the Same Metz Motor and the Original Generator. The Above Improved Machine Resulted in* 1929. *This Served Very Well Until* 1936 *When the Old Metz Motor Breathed Its Last. Consequently the Outfit Is Now Going Through the Third Rehabilitation by the Installation of a New Model "A" Ford Engine and Substituting Wire Wheels with Pneumatic Tires.*

Illinois Experiences

The information received in reply to the questionnaire sent out by the writer, is presented in Tables 7 and 8. There is no tie in, between the number of thawing units used, and the cost. For example, in some cases the thawing equipment was given, but no unit costs, and so on down the line. Not everyone answered the questionnaire in full. But the information as tabulated relative to the policy generally followed by water works throughout Illinois on the methods used in thawing, ownership of equipment, costs, who stands the cost of thawing, and responsibility of water waste to prevent refreezing is of interest, and value.

Methods used in thawing and the ownership of the equipment are reported in Table 7; Costs per service thawed, in Table 8.

TABLE 7—THAWING METHODS

Gasoline engine generators (welder type)	20
Transformers	17
All other methods	4
Water works owned equipment	14
Water works did not own equipment	13

TABLE 8—ILLINOIS COSTS PER SERVICE THAWED

	Welder	Transformer	Other
$ 1.00 to $2.00	2	1	1
2.00 to 3.00	2	1	1
3.00 to 4.00	3	3	..
4.00 to 5.00	4	1	..
5.00 to 6.00	..	..	..
6.00 to 7.00	..	1	1
7.00 to 8.00	..	..	..
8.00 to 9.00	2*	1	1
9.00 to 10.00	..	1	..
10.00 and over	3*	4	..

*Rented equipment.

Who Pays the Cost?

"Who pays for the thawing of service?" is of great concern to the operator. In some cities the service is owned and maintained by the property owner only from the curb into the house. To determine the actual portion of the service frozen takes time, which in winters like that of 1936, and with consumers waiting for relief, time is too valuable to waste in making an investigation. A few operators did take the time to determine the point of freezing, however. They charged the property owner, if frozen from the curb into the house. The water works stood the expense if it was found to be frozen between the main and the curb box. In other places the customer ownership extends to the main, in which case there is no doubt as to the responsibility.

Regardless of the extent of ownership of service pipes, a greater number of water utilities thaw at their own expense, rather than charge the consumer.

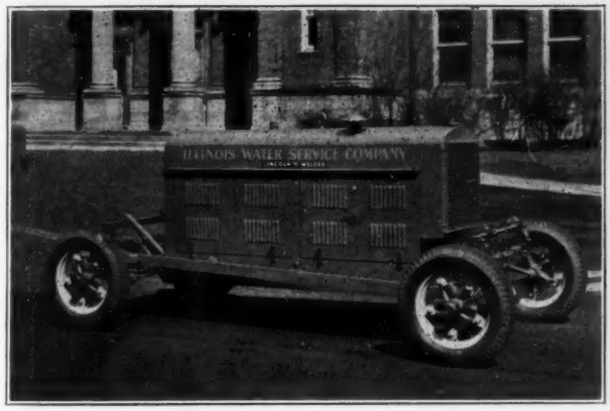
TABLE 9—COST ALLOCATION

Water works pays for thawing	12
Consumer pays for thawing	10
Cost is split in case of question of point of freezing, water works pays one-half, property owner pays one-half	2
Water works thaws once free, subsequent freezing paid by property owner	4

One plant making no charge for the first thaw reported a charge of $6.00 plus $3.00 an hour for every additional hour over two hours when called back to thaw a service a second time, while another plant charges the consumer the cost on the second thaw.

The Cost of Wasting Water

"Who pays for the waste when allowing the water to run after a service is thawed, to prevent refreezing?" Most operators have wanted to know what policy other cities were following in this respect. Those answering the questionnaire furnished the information for Table 10.



Our Store Bought 1936 Model Lincoln. With So Many Services Frozen at One Time Last Winter, the Above Welder Was Purchased in Order That We Might Give Better Service to Consumers in Distress. With an Output of 150 to 600 Amperes at 40 Volts It Proved a Life-Saver.

TABLE 10—HOW WASTED WATER IS PAID FOR

Adjusts bill (no basis specified)	2
Water works pays excess	14
Consumer pays excess	8
Consumer pays excess only if service is frozen between curb and house	2

One city gives a written notice to the consumer at the time the thaw is made, which serves as his certificate of adjustment when payment of water bill is made.

"Do's and Don't"

"Do's and Don't" of electric thawing as taken from the answers to the questionnaire:

"Use smallest current possible to accomplish job; do not hurry by using heavy currents."

"Watch that you do not burn connections between pipes or melt lead joints."

"Be sure to get good electrical contact at fire hydrant, curb box, etc."

"Be sure all house wiring ground connections are removed from the water pipe, and remove meter. While another removes the gas meter."

Not following this simple precaution has caused great damage and it is the writer's recommendation that the water meter *always* be removed or the service line be otherwise disconnected to avoid thawing current from running over the house piping and jumping to the electrical wiring system. Failure to remove the meter in one case caused a house fire by the current feeding back through a house circuit, which, of course, does not have sufficient capacity for such heavy currents. Another grave danger of not removing the water meter is the possibility of feeding the current through the gas line by way of the hot water heater. This will probably melt the lead gaskets in the gas meter, creating a potential hazard from escaping gas.

"Conditions which should be guarded against"—Damage to electric meter (using transformer) and rubber gaskets in fittings; using wire of improper size and design for the equipment, and not making connections through too short length of service line.

Concerning this last condition (that of thawing a short line) the current may be regulated by using a control in the secondary of the transformer, or on the output of the generator; either salt water or rheostats may be used.

"The particular condition we have come in contact with is the possibility of burning out lead goosenecks on the main . . ., used 500 amps on 110 V circuit."

". . . Our experience showed it better to connect one cable to a hydrant instead of to the service pipe in an adjoining house. Heavy currents . . . generally burning corporations, lead expansion joints or curb stops."

"It should be borne in mind, that when using the 110 V transformer . . . care must be exercised that tight connections are made both on the water service and on the hydrant, and that the lead pipe or joints in the main are not damaged."

"We employ an electrician from . . . the power company to connect the thawing machine (transformer) with the . . . distribution lines in the alley, instead of connecting a transformer with the switch box in the house, as the leads into the house are too small."

The question as to materials which withstand freezing the best, did not bring forth any information of value. Some reported lead and copper would not rupture, while others reported ruptures in both. It was unanimous that more trouble was experienced in steel and wrought iron than copper and lead, but the trouble here was due to corrosion by age leaving only a shell of a pipe which had insufficient strength to withstand the internal pressure caused by freezing.

Thawing Mains

Although the questionnaire was confined to experiences with frozen services, three added some information relative to thawing mains. This is included here because of its close relationship to the subject of this paper, and because of its interest.

"We had two mains frozen. One was a short piece of dead end 6-inch pipe and the other perhaps 100 feet of 4-inch pipe. One of these thawing outfits (welder type) spent 18½ hours thawing these two mains at a cost of $45.64 for both, including the time for our man and truck and the welding outfit and man."

"We had one 4-inch main frozen . . . Thawed by electrical method in ten minutes. . .. Cost $10.00."

"We had one 6-inch main frozen, dead end with one consumer. . . . Thawed electrically in two hours. . . . Cost, $20.00."

Suggestions

In conclusion, the following suggestions are reviewed:

Special care should be taken to see that all connections are tight. Rust, scale, grease, etc., should be removed from the pipe at point of contact and the leads from the welding machine should be securely clamped in place. Ordinary "C" clamps are generally used for this purpose, although some users bind the cable to the pipe with copper wire. If connections are not tight, arcing may result in holes burned in the pipe. Furthermore, loose connections waste energy and slow up the thawing operation.

While some users report that they find it best to connect the positive lead from the machine to the point nearest the frozen section, others have reported instances where the ice nearest the negative lead connection thawed first. It would, therefore, appear that this depends largely upon local conditions and that it does not really make much, if any difference, as to how the leads are located for polarity.

Gas pipes, etc., should be checked to see that they are not in contact with the water pipe. It doesn't take long to remove such hazards and the customer should not object to the slight extra time required to take such safety precautions.

The higher the current that can be safely used in the circuit the quicker the job can be finished. Care should be taken, however, to keep the current value within safe limits. Continually check connections and joints to see that they are not overheating. Also be careful not to put a severe overload on your welding machine for too long a continuous time.

Acknowledgment.—The above paper was presented before the Illinois Section of the American Water Works Association.

▼

Arthur Bedell Heads Bureau of Wastes Disposal

A. S. Bedell

In a recent issue we announced the establishment of a Bureau of Water Supply in the Division of Sanitation of the New York State Department of Health. Another bureau has just been established —that of Wastes Disposal. This bureau is to be placed under Arthur S. Bedell, as Chief of Bureau. The new bureau is to have general supervision over the control of stream pollution and waste disposal, the examination of plans for the treatment of plans for the treatment of sewage and wastes, and supervision over operation of such plants. The bureau will conduct a program of research in cooperation with the department's Division of Laboratories, and will organize short schools on a regional basis, which are being located and designed to reach the greatest number of operators.

Mr. Bedell has many years of experience in sanitary engineering and public health work to his credit. Also, he has capably served the New York State Sewage Works Association as its Secretary since its beginning. It is a pleasing recognition of his efficient service and diplomatic personality, that Mr. Bedell has been chosen by his division—C. A. Holmquist, Chief Engr.—to head the new Bureau of Wastes Disposal.

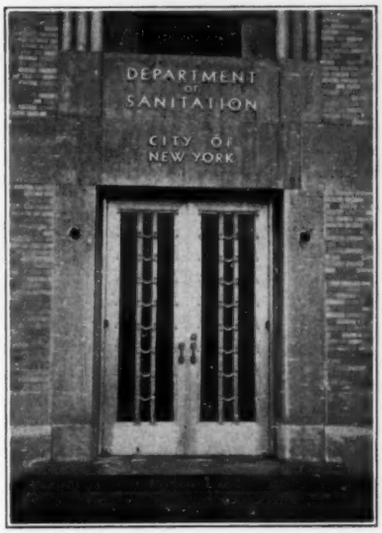
▼

Pittsburgh's Colonel Rockwell Takes On Another Job

Colonel Rockwell

Colonel W. F. Rockwell, President of the Pittsburgh Equitable Meter Co., has a lucrative hobby. He has a new job to add to his collection—namely, the Chairmanship of the Board of Directors of the Standard Steel Spring Company of Coraopolis, Pa. We understand this company, with four plants, to be "the World's largest manufacturer of automobile springs."

Besides being President of the Pittsburgh Meter Company and Merco Norstrom Valve Company, the Colonel is president of "just a few" others, including H. A. Smith Machine Co., Midwest Equitable Meter Co., Meter Parts Co., Timken-Detroit Axle Co., Wisconsin Axle Co., Timken Silent Automatic Co. and possibly others. With all these jobs the Colonel still finds time to serve as Director of the Kensington Water Co. and Tri-Cities Water Co.; and, besides, has recently been very active in the War Department as advisory officer on Army Motorization and Mechanization.



Entrance to Coney Island Treatment Works Headhouse. (To All Appearances the Headhouse of a Water Filtration Plant.)

LARGEST SEWAGE WORKS ASSN. STAGES RECORD-MAKING MEETING

Activated Sludge Control; Garbage Digestion; Coney Island Plant Featured

A RECORD in attendance was established for the Annual Meeting of the New York State Sewage Works Association on January 22nd and 23rd in New York City.

An innovation in meeting arrangements this year proved as successful as contemplated. Two sessions of the Sanitary Engineering Division of the American Society of Civil Engineers, on January 21st, was followed that evening by the newly scheduled Joint Annual Dinner of this Division and New York State Sewage Works Assn., heretofore held earlier in the week. A record number (171) attended this dinner. The feature of the evening was the illustrated story of the past, present and future of Cleveland's (Ohio) program of sewerage betterments and sewage treatment as interestingly unfolded by George B. Gascoigne, a native son and nationally known consulting sanitary engineer, who has literally grown up with Cleveland's sewerage developments. Mr. Gascoigne's paper, revealing many innovations in modern plant design, will appear in "Civil Engineering."

On the day following the meeting of A.S.C.E.'s Sanitary Engineers which ended with the annual joint dinner, was held the meeting of the N. Y. Sewage Works Assn. And, the forenoon of the day following (Saturday) was devoted to a joint trip of inspection—this year to New York City's new Coney Island Sewage Treatment Plant. In a police escorted caravan of 89 automobiles [54 of which were supplied through the courtesy of Sanitation Commissioner Walter D. Binger, who personally conducted the trip] 200 members and guests were whizzed out to America's largest chemical treatment plant and back in time for luncheon and afternoon divertissements.

Linn H. Enslow, Retiring President

Chas. C. Agar, Incoming President

All in all, the contiguous three days of meetings and associated activities, of interest to sanitary engineers and sewerage authorities, proved ideal in respect to utilization of time. Likewise, incurred a minimum of expense to those coming to New York for the purpose of attending both meetings. The result becomes apparent in the following attendance records—Annual Joint Dinner, 171; N.Y.S.S.W.A. Meeting, approximately 300 (actual registration 280); Inspection Trip, 200 or better.

Prof. Hyde an Engaging Luncheon Speaker

At the luncheon, attended by 225 members and guests from 13 sewage works associations, the president—Linn H. Enslow—commented on the pleasingly large number of out of state visitors, many of which he introduced. Interestingly, two were from Colorado and four were from California, including the luncheon speaker, Prof. Charles Gilman Hyde who heads the Sanitary Engineering Department of the University of California. Professor Hyde, who the president introduced as "a consulting engineer of parts" and a "regular fellow," in his pleasing and engaging manner briefly recounted many of the most interesting modern developments and trends in sewerage and sewage treatment. He especially stressed the value of operator training, short schools, and the advantages to be derived from some form of

Award Winners

Dr. A. S. Fischer (Research) — *C. Geo. Andersen (Operation)*

operator licensing act to protect operators and plant managers. A high spot: "Politics should not be mixed with education; nor with water; nor even with sewage." He complimented the New York association for having established an award for the operator presenting the best operating report during each year. To him, good plant operating records meant nothing less than good operation. Professor Hyde, in commenting on the existing interest in garbage disposal by way of sewers and sewage treatment, warned against over-enthusiasm toward this method. Such, was to his mind, a problem not to be lightly taken. In review of progress in research he complimented many investigators, individually, for their contributions.

Professor Hyde then turned to developments in the chemical treatment of sewages and its widening application in assisting and bettering biological processes. In this he mentioned the established and widening application of chlorine for a variety of purposes; the use of activated carbon to stimulate and aid digestion; the effectiveness of iron salts in precipitation, odor control, digester performance and sludge dewatering. When it came to the question of "Chemical vs. Biological" he contended that there was hardly ground for a debate, because both to his mind were to be used for a long time to come. Although the biological processes were likely to show the greatest improvements and advances in future years, each method would hold its justified place, with selections being based on both technical and economic reasoning.

Concerning biological methods, the new and more economical processes of procuring bio-precipitation (flocculation) of putrescibles in sewage, was deserving of a wider interest. In this he referred to the use of the trickling filter with markedly increased loadings (application rates) which became, thereby, an instrument of bio-flocculation. On the same score, the possibilities of the first stages of the activated sludge process, demanded further attention. In either event some form of effluent filtration (straining) after settling would seemingly become an important step in the process; this, in order to hold the economically produced flocculated material, some of which would be of slow settling gravity. In this connection he pointed to results attained with the aid of iron salts to assist bio-flocculation, thereby allowing increased process loadings.

(Professor Hyde's comments were selected from a prepared review of developments in sewerage and sewage treatment. The first installment of this paper appears on another page, as a featured article which had been prepared by him for this issue.—Ed.)

Fred J. Biele, (Huntington) Vice President — *Geo. B. Gascoigne, (Cleveland) Dinner Speaker*

Awards

At the luncheon session the following awards were presented by the president to two members.

To Dr. Anthony J. Fischer, Dorr Company's Research and Development Chemist, was presented the Kenneth Allen Memorial Award for research. This for his meritorius paper—"The Economics of Various Methods of Sewage Sludge Disposal"—which was presented before the association in January, 1936. Dr. Fischer's paper is to be found in Sewage Works Journal (March, 1936) and in WATER WORKS AND SEWERAGE (March, 1936) and represents the most inclusive analysis of sludge disposal methods yet available.

Walter D. Binger, Engr.-Commissioner of Sanitation — *Richard H. Gould, Chief Engr., N. Y. Dept. of Sanitation*

To C. George Andersen, Rockville Center's (L. I.) Superintendent of Sewage Treatment, went the Kenneth Allen Memorial Award for operation. This, for his outstanding paper and report covering plant operation and operation betterments at Rockville Center. Mr. Andersen's paper—"Observations on the Operation of an Activated Sludge Plant"—was presented before the association in June, 1936. It has since appeared in Sewage Works Journal (Sept., 1936) and WATER WORKS AND SEWERAGE (Sept., 1936).

[To us it becomes a pleasure as well as our duty to recommend the wide reading of Mr. Andersen's eminently practical paper and Dr. Fischer's worthy studies and analyses of sludge disposal and its costs.—Ed.]

Business Session

Clinching its claim to being the "World's Largest Sewage Works Association," Secretary Bedell revealed that the meeting opened with a membership of 450, closed with a gain of 36—making the new total, 486 members. He added that the policy of establishing regional sections had proved a profitable move of a year ago. The Long Island Section now boasted 76 members and only recently an "Up-State Section" had organized for a "trial period," looking toward a permanent organ-

ization. [One interesting feature of these prolific sections is that the member may come in first as a *section* member, only, with very nominal dues. He then is encouraged to take membership in the parent association and, with it, receive Sewage Works Journal. The membership fee for "working operators" is less than the regular fee charged others more able to afford it.—Ed.]

The treasurer reported that in recent years a net loss had been sustained ($114.00 in 1936) because of expenses in connection with the three meetings held each year. The reserve in bank had been depleted now to the extent that a minor (adjusted) registration fee would have to be collected at the Spring and Fall meetings in the future, to limit the depletion of reserve funds.

Of the reports presented by the several committee chairman, especial interest was shown in that of the Committee on Gadgets, indicating the success of the first Gadget Contest at the Fall meeting. According to Chairman Sweeney, "Bigger and Better Gadgets" were anticipated for the 1937 Fall meeting at Elmira early in September. Of these gadgets too bulky to be transported readily or too essential to remove from the plant, photographs or drawings with descriptive explanation would be acceptable entries in the contest exhibit.

The Spring meeting, at which manufacturers' (equipment) exhibits are to be featured, is to be held in Utica on June 4th and 5th. [These dates were selected because Utica is on the road to Buffalo where the American Water Works Association will hold its Annual Convention, scheduled for June 7-12th, thereby allowing many to attend both meetings.—Ed.]

Resolutions and Officers

Amongst the resolutions was that lamenting the death of two members since the Fall meeting—Nicholas S. Hill, Jr., and John E. Dowd, both engineers of New York City.

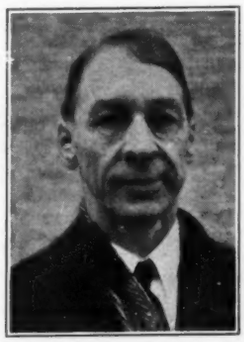
Another resolution carried the Association's plea for Federal aid and support in advancing stream cleansing and regulating stream use. To this end the resolution favored the so-called Barkley anti-pollution bill now before the Congress as being the most commendable of any of the seven or eight bills thus far introduced. Authority was voted the Executive Committee to support the current Barkley bill until such time as an amended or a new bill appeared which seemed to have preferable or more workable features. Therewith to act with authority and judgment in behalf of the association.

The following constitute the roster of officers for 1937:

President—Chas. C. Agar, State Dept. of Health, Albany.

Vice-Pres.—Fred J. Biele, Consulting Engr., Huntington.

Prof. W. L. Malcolm, Queens University, Kingston, Ont.



Prof. C. L. Walker, Cornell University, Ithaca, N. Y.

Wellington "Duke" Donaldson, Engr. of Treatment, N. Y. Dept. of Sanitation

Newel Nussbaumer, Buffalo Consulting Engineer Director of the Assn.

Secy.-Treas.—Arthur S. Bedell, State Dept. of Health, Albany.

Members Exec. Comm.—Newell L. Nussbaumer (Buffalo); E. J. Kilcawley (Troy); Chas. McGreen (Orangeburg).

Board of Control, Sewage Works Federation—Linn H. Enslow; Chas. C. Agar. (Mr. Enslow was thereafter elected by the Federation Board to serve as Vice-Chairman of the Board of Control of which C. A. Emerson continues as Chairman and H. E. Moses as Secretary.)

Technical Session

The opening paper was a particularly interesting and well presented discussion of the behavior of the activated sludge process. Prepared by Messrs. Milton Spiegel, Stanley E. Kappe and Gilbert M. Smith, sanitary and development engineers with the Chicago Pump Company, the paper was presented by Mr. Spiegel under the title:

"Control of the Activated Sludge Process"—The authors pointed out the fact, supported by data graphs, that there existed an exceedingly variable *rate* of oxygen demand (oxygen utilization), starting at the inlet end of aeration tanks and thenceforth diminishing enroute to the effluent end. They emphasized this feature of the activated sludge process as one of highest and determining importance. It was, therefore, apparent that the technical and economical success of the process was basically dependent upon balancing the ratio of sludge returned, only to that required for the job at hand (the sewage being dealt with), and to supply the aeration necessary to keep pace with the rate of oxygen utilization as it occurred at various points through the tanks. To maintain the effective oxygenation balance would require, for highest operating economy, stepped ("tapered") aeration in which the highest rate was demanded in the inlet end of the aerators and the lowest at the effluent end.

In considering rates of oxygen utilization, three major factors entered: (1) the activity (not volume or mass) of the sludge; (2) the type of materials in the sewage; (3) temperatures (rate of bio-activity). To evaluate such rates and sludge activity the "Odeometer" (oxygen demand meter) had been developed by Nordell. The "Nordell Number," used as the measuring stick, was nothing more than the measured rate of oxygen utilization expressed as parts per million per hour—p.p.m./hr. With the "Odeometer" the findings by Kessler, at representative plants, had been confirmed through the development and study of many individual oxygen utilization rate curves. Typical curves picturized the maximum rate (Nordell Number) of oxygen utilization during

various lengths of time following sludge introduction to the sewage. After the initial maximum rate there followed the fairly rapid slowing off of the rate and, thereafter, the gradual approach to the almost horizontal (slow) but sustained rate always observed with well behaving and effectively activated sludges. The most interesting phase was that the observed maximum rate at the inlet of aeration tanks proved practically identical for normal as for weak sewages. However, the time, over which the maximum rate persisted, varied directly with the sewage strength, as did the required hours of activation, before the efficacy of the process could be considered satisfactory and dependable. From such observations the authors stated that two laws could be drawn. The first: "For a given condition of returned sludge the aeration period required must be directly proportional to the strength of the pre-settled sewage." The second: "Where the sewage strength is the same the requisite period of aeration to produce well conditioned sludge varies inversely with the *maximum* sludge activity."

Applied in plant operation the only two variables subject to control were: sludge activity and oxygen supply. The first could be most readily determined with the "Odeometer"; the second, the sufficiency of oxygen supply, by dissolved oxygen tests at critical points through the aeration units. Other useful indicative tests were the sludge settling tests so widely used to determine effectiveness of flocculation and settleability, and the sludge "density index" which is the ratio of sludge volume to weight of dry solids (parts per million) in the mixed liquor. To effect adequate control, maximum sludge activity permissible for the sewage at hand should be maintained. And, only by providing sufficient oxygen input to keep abreast of the demand rate (during the maximum required period of aeration) for average, for minimum and for maximum strengths of the sewage being treated, could this end be attained. Sludge activity was subject to control through varying the program of wasting (conversely the return) of sludge produced.

The main advantage from the recommended control methods was admittedly that of purification enhancement. However, a secondary, but especially important item to large plants, was the maximum oxygen economy through the tapering off of air input to produce worth while power cost savings. The authors had figures available to show an annual saving of $20,000 could be expected at one important plant, notwithstanding the fact that what was considered to be a "weak" sewage, easily treated, was being dealt with at that plant.

(Mr. Spiegel's paper will be printed in full in a near future issue of this magazine.—Ed.)

From California They Came

C. G. Gillespie, Chief Engr. State Dept. of Health

Harold F. Gray Berkeley, Consulting Engr.

And, from Carolina and Colorado

H. G. Baity, (Chapel Hill) Pres. of the N. C. Assn.

Dana E. Kepner, (Denver) Secy.-Treas. of the Colorado Assn.

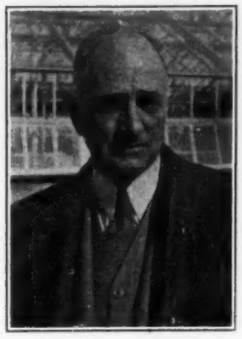
GEORGE B. GASCOIGNE (Cleveland, Ohio) was asked by the Chair to comment on Mr. Spiegel's paper, in view of his plans for incorporating tapered aeration in Cleveland's bio-flocculation plant, ahead of trickling filters. Mr. Gascoigne stated that since the plant was not yet in operation he could only hope that the results would be those which the "Odeometer" tests had predicted, and which appeared reasonable.

DR. W. RUDOLFS (Rutgers Univ.) emphasized that the oxidation stage of the activated sludge process was only a part of the story, and that a better understanding was needed of the early stages wherein the major performance was that of coagulation and clarification—namely, the bio-flocculation stage wherein the maximum work per dollar of expense was accomplished.

DR. F. W. MOHLMAN (Chicago) complimented Mr. Spiegel and his associates for their work on sludge activity as measured by the "Odeometer." He, too, pointed out the importance of the clarification and adsorption phenomena observed in the rapid first stage of purification. He did not believe that rates of oxygen utilization were necessarily synonymous with sludge activity. And, stressed the value of control of solids, plant operation, by means of the very practical centrifugal method of suspended solids determination at frequent intervals. Likewise, of high importance was the testing for dissolved oxygen at critical points in the aerators. Of real practical value, these tests had been used for some years at Milwaukee, Chicago, and elsewhere—more recently had proved their value at Rockville Center, L. I.

C. GEO. ANDERSEN (Rockville Center, L. I.), upon invitation of the president, explained his operation control method, which involved centrifugal tests to guide the operator in varying sludge return rates in accord with sewage flow variations. Also, the use of the principle of what he had learned to be "tapered" aeration to maintain at least some dissolved oxygen in the mixed liquor at all points. To make variations in sludge return control practical, it had first been necessary, at his plant, to produce and maintain a sludge of consistent solids concentration before effective control through a varied volumetric return could be held dependable.

PROFESSOR GORDON M. FAIR (Harvard Univ.) said that he had followed the work of Kessler, Nordell and Spiegel with interest, and that on analysis, their sludge activity (oxygen utilization) curve appears to break down into three oxygen demand curves: (1) a basic demand equal to that observed in fresh sewage; (2) a demand 15 times as fast, probably representing the oxidation accomplished on the activated sludge flocks; (3)



From Iowa and Rhode Island

Prof. F. M. Dawson, Dean of Engineering at Iowa

Julius Bugbee, Supt., Providence, Treatment Works

a demand again 10 times as fast, taking place during the clarification stage. Further, 90 per cent of the first demand is satisfied in 10 days; 90 per cent of the second demand in 16 hours; 90 per cent of the third demand in 1.6 hours. Such values correspond respectively to (1) the average time during which activated sludge is kept in circulation; (2) the time of aeration of strong sewage in England; (3) the time of the so-called clarification stage. It would seem that the three basic demand curves throw some light on the mechanism of the activated sludge process.

PROFESSOR EARLE B. PHELPS (Columbia University) commented on the limited capacity of sewage to absorb oxygen beyond a certain maximum rate. If the rate of utilization exceeds this maximum possible rate of absorption, a deficiency will exist at the inlet end of aeration tanks which, possibly, can be only partially compensated by an increased length of aeration. It had been suggested that a more suitable remedy for such a condition might be slowing down the initial rate of utilization by partial chlorination. This suggestion and the further observation that Sphaerotilus may be a symptom rather than a cause of bulking, and that the fundamental cause may be due to the above mentioned conditions had been tentatively suggested by Mahlie (Texas) in the forthcoming "Review of Sewage Research for 1936."

Mr. Spiegel was asked for his suggestion of changed control to meet day and night and strong and weak sewage conditions. In reply, he thought that some form of sludge storage during the night in re-aeration units should be considered. These "shock-troops" (well aerated sludge) might profitably be held in reserve for use the following day, or hour, when most needed. The difficulty of keeping abreast of the oxygen demand rate should be materially lessened if a small quantity of chlorine be introduced continuously with the air to suppress the rate of sludge activity during the period of aerated storage, which had been difficult to keep abreast of in previous attempts to hold sludge in storage.

(Because of the luncheon hour, already 35 minutes over-run, the flow of interesting discussion had to be cut off.—Ed.)

Afternoon Session

"Effect of Activated Carbon on Sludge Digestion" —By PROF. C. L. WALKER, Cornell University, Ithaca, N. Y.

This extensive study of the effect of carbon on sludge digestion and gas production included data obtained on laboratory, pilot, and plant size equipment. Characteristics of sludge, amount and quality of gas, and the rate of production were the pertinent determinations reported.

One gallon digesters, operated at three temperatures (20, 28 and 45° C.) were used in the first group of studies. The dose of carbon was varied between 0 to 45 p.p.m. In this group, only at the 20 degree temperature was a beneficial effect noted, and the smaller doses of carbon proved most desirable. When digesters were maintained at 28 degrees that receiving no carbon seemingly gave best results. Those receiving carbon showed a decrease in the amount of gas produced with each increase in the amount of carbon. At 45 degrees a similar effect was apparent. With respect to sludge drainability, a carbon dose of 30 p.p.m. at 20 degrees produced the sludge of best characteristics. Results were not so striking from 28 degrees, digestion. At 45 degrees the low carbon dose was best.

At Coney Island

(1) W. L. Sylvester (San Engr.), New York City (2) Chas. Young (San. Engr.), Meadville, Pa.; (3) W. W. Highberger, Mathieson Alkali Wks.; (4) Frank C. (Cripple) Roe, Carborundum Co.; (5) Frank Holland (Commissioner), Freeport, L. I.; (6) Glen E. Pinkney (Operator), Webster, N. Y.; (7) A. L. Genter (Chem. Engr.), Baltimore, Md.; (8) W. E. Wechter, (Engr.), Worthington, Co.

A large amount of graphical data was presented by means of slides, both on the laboratory digester results and for the Ithaca separate sludge digestion plant. Gas production at this plant averages close to 1 cu. ft. per capita per day. After the regular addition of carbon to sludge as it was pumped to the digester, gas production showed a decrease. Repetition of the experiment produced the same results and the only desirable effect was to show a maintained increase in the temperature of sludge during the use of activated carbon.

Left to Right: Wm. R. Copeland, State Water Comm., Hartford, Conn.; E. T. Killam, Cons. Engr., New York City; Earl L. Waterman, Secy. A. S. C. E., San. Engr., Iowa City, Ia.

At Coney Island

(1) Prof. L. V. Carpenter, N. Y. Univ.; (2) Harry Eichenauer, Operator, Liberty, N. Y.; (3) Charlie Wycoff, Wallace & Tiernan Co.; (4) Al. Johnstone, Wallace & Tiernan Co.; (5) Charlie Emerson, Cons. Engr., New York City; (6) John C. Lawrence, Supt. of Works, Liberty, N. Y.; (7) Wm. A. Ryan, Cons. San. Chemist, Rochester, N. Y.

To study this condition in detail, a large series of 55 gallon digesters with gas collection tanks was devised. This set-up permitted running carefully control comparative tests.

Professor Walker summarized the detailed results as warranting the following conclusions: (1) That activated carbon does reduce odors; (2) that at 65° F. the addition of carbon is more effective than at 85° F.; (3) such addition will increase sludge drainability, reaching a maximum effect at 30 p.p.m. dose; (4) at 24° C. treated sludge digested more completely, but this was not true at 28° and 45° C.; (5) treated sludge showed no increase in gas production, and sludge treated with the higher doses actually showed a decrease in gas production; (6) treated sludge produced a gas higher in methane content.

In the limited discussion time available Professor WILLEM RUDOLFS, Director of the N. J. Agr. Expt. Sta., was asked by the Chair if he would comment on these results based on his own conflicting findings. He complimented Professor Walker for the unusual care and extent of the experiment. It was his opinion, however, the analytical data showed an unexplained low methane and high hydrogen content. This might be explained on the basis of acid conditions or because of an improper relation between ripe sludge and fresh solids.

MR. ENSLOW commented that the beneficial effect produced by activated carbon addition in low temperature digestion might warrant such use when digesters are not operating properly and when digestion capacity is inadequate. This much seemed well established. Professor Walker's findings was another instance that in sewage treatment "every tub must rest on its own bottom" when comparing conditions met with. As to be recorded, the Baltimore studies had shown beneficial effects from carbon. [This report appears elsewhere in this issue.—Ed.]

"The Digestion of Ground Garbage—a Study"—By Professor WILLIAM L. MALCOLM, Queens University, Kingston, Ont., Canada.

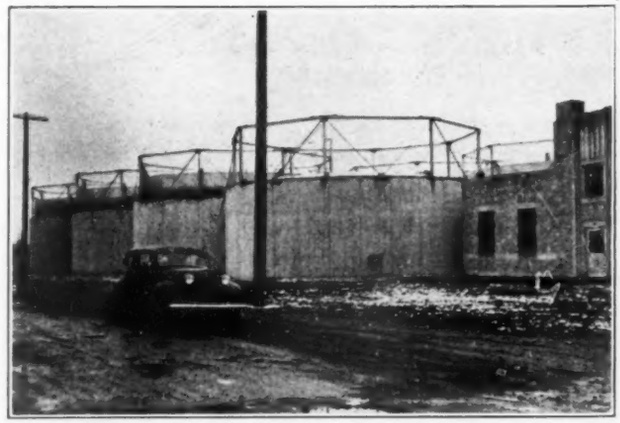
The same 55 gallon digester and gas collection tank set-up as used in the preceding experiments was utilized by Professor Malcolm in so proficiently studying the digestion of garbage with sewage sludge.

His discussion of results of digesting garbage solids with sewage sludge was confined largely to those obtained in the summer of 1936, in which definite ratios of sludge to garbage and, finally, garbage alone was digested. Garbage was ground with a G.E. Home Grinder Unit and, therefore, had a relatively high water content. The digestion study extended over a period of 150 days, and analyses showed the moisture, volatile matter, and pH, to remain quite uniform through the run, with the exception of those tanks where garbage alone was being digested. In the latter case, no gas at all was evolved for a considerable period.

The normal ratio of sludge to garbage, which appeared typical if the process were applied on a municipal scale was, 1 of sludge volatile to 1.5 of garbage volatile, both on the dry basis. Above and below this ratio other combinations were compared, such ratios as sludge volatile to garbage volatile of 1 to 2 and 1 to 1, being employed. While the mixtures of sludge and garbage digested with the production of somewhat less gas than was produced by raw sludge digestion, the digestion which finally was produced in garbage alone reached a higher gas production than did the raw sludge. It was apparent that the acid condition, which early set in, prevented gas formation in digesting garbage alone until corrected with lime.

Variations in gas analyses were not appreciable. Averages showed the gas to be 26 per cent CO_2, 54.6 per cent methane, and 5.65 per cent hydrogen. Gas production in cu. ft. averaged 10.63 for controls (sludge alone); 10.5 for the various garbage-sludge mixtures; 12 for garbage alone. No foaming or scum accumulation was apparent, even after the run of 151 days' duration. Professor Malcolm concluded that on the basis of scum production, solids determinations, and gas production (in quantity or quality) there was little qualitative or quantitative difference in digestion of the various mixtures.

The paper which was illustrated by well presented graphical data and photographs of equipment, suffered from lack of proper time for presentation. It received considerable discussion and deserves more.



Coney Island's 8 Sludge Digesters with Floating Gas Holding Covers. Gas Engine-Power Station on Right.

MORRIS COHN called it a monumental study productive of conclusive results. In answer to a question by Prof. Rudolfs, the author stated that the ratio selected as typical was based on actual volume of sludge and garbage which would be found at Ithaca. He added that the considerable water required in grinding with the type of machine employed had been added to the mixture to prevent loss of soluble constituents.

L. R. SETTER, New York University, questioned the difference in solids balance as shown by analyses, and asked if this was due to the destruction of volatile matter. Prof. Malcolm replied that a 100 per cent balance was generally believed impracticable, if not impossible.

[A brief review and extended discussion of Prof. Malcolm's important paper is scheduled for the next meeting of the association at Utica, N. Y., June 4th and 5th.—Ed.]

"Progress in Sewage Treatment for New York City" —By RICHARD H. GOULD, Chief Engineer, Dept. of Sanitation, New York City.

Mr. Gould to conserve time devoted his remarks to a review of actual accomplishments in the New York sewage program during 1936.

Most important was the Coney Island plant, for while of only 35 m.g.d. capacity, the operation of this plant has initiated the program of modern chemical treatment which is being developed. In addition to the Coney Island plant the antiquated system of New York City now consists of: 8 fine screening plants with chlorination facilities at 3, 1 septic tank, 1 plant for chlorination alone, and 3 with only coarse screening facilities. Existing plants treat but 12 per cent of the city's sewage and only 3 per cent of the total solids are retained. The Coney Island plant alone accomplishes 40 per cent of this total removal. The Coney Island plant replaces 3 older plants, and the cost of operation already indicates an annual saving of $50,000 which is about one-third of the total operating cost for the plant.

In addition to the Coney Island plant, which treats sewage by means of sedimentation, separate sludge digestion, seasoned chemical precipitation and chlorination, the construction of those plants which contribute to the pollution of Flushing Bay is being hastened to correct such conditions before the 1939 World's Fair. The ultimate program will require the expenditure of 200 million dollars, of which about one-quarter has now been spent. One-third of the amount will be utilized when the works now under design are completed. The Ward's Island plant will be in operation in 1937 and the first contract has been let for the Tallman's Island plant. In both of these the activated sludge process will be employed. At the Ward's Island plant sludge will be barged to sea in the three 1500 ton sludge vessels. Operation of the plant awaits completion of difficult tunnel sewers. Mr. Gould described and showed pictures of some of the difficult situations encountered and left description of Coney Island plant operation for the next interlocking paper.

"Preliminary Operations of the Coney Island Sewage Treatment Plant"—By WELLINGTN DONALDSON, San. Engr., Dept. of Sanitation, New York City.

Mr. Donaldson briefly described the Coney Island plant, the largest U. S. plant in operation which provides year round clarification and summer treatment by chemical precipitation.*

The impossibility of completing contracts by July of 1935 when sewage was first received at the plant, forced the use of many makeshifts the first season. Chlorine to the amount of 900 lb. daily was supplied by adding chloride of lime and enabled the carrying of a 0.1 to 0.5 p.p.m. residual. Removals by plain sedimentation had averaged 13.6 per cent of the suspended solids and 21 per cent of the B.O.D.

The application of chemicals was necessary to increase the removals for the 1936 summer season, and while chlorine was used for prechlorination, lack of pumping facilities to operate the equipment prevented the intended use of chlorinated-copperas for coagulation. As a substitute ferric sulphate ("Ferrisul") was used but solution of the material proved difficult with the makeshift dissolving facilities, even though hot water was available. Over the period June 20th to October 23, 1936, about 2,540 million gallons of sewage were treated at a total cost for all chemicals (chlorine, ferric sulphate, lime) of $20,000.

Describing results of what he termed, makeshift treatment, Mr. Donaldson explained that the sewage is very stale in the summer months. This fact and the extremely wide variation in sewage loads increases the difficulty of treatment. During the months of non-chemical treatment, laboratory data showed a suspended solids removal of 44 per cent, of B.O.D. 31 per cent. With chemical treatment and pre-chlorination the figures were increased to 61 per cent and 51 per cent respectively. Chlorine was applied in the wet well and an attempt was made to maintain the residual through the settling tanks. While the dose of 100 lb. of chlorine per million gallons did not satisfy the chlorine demand, it did provide complete nuisance control, improved clarification efficiencies and gave exceptional bacteriological results.

Since May 21st all sludge has been digested, while prior to that time it had been disposed of by barging to sea. Each of the 8 digesters is of 56,000 cu. ft. liquid capacity, but the number in use will vary with the seasonal load on the plant. Since heat has been available the temperature has been maintained at 83° F. and both plain and chemical sludge digests satisfactorily. Supernatant liquid is returned to the wet well. Digested sludge has thus far been used for land fill, and ultimately conditioning with chemicals and dewatering on vacuum filters will be employed.

The peak gas production was about 300,000 cu. ft. daily. Three 300 h.p. Worthington gas engines are available to utilize the gas for power in generating electricity. Since November 1st, the *entire* electric load of the plant had been carried by this process. So sure of the dependability of this power source had they been, that connection to utility lines had been severed. The power generated is sufficient to pump all sewage and operate the various electric motors in the plant. In December 3,541 KWH. per day were produced, for which 23 cu. ft. of gas was required per KWH.

The author of the final technical paper on the program offered, because of limited time, to hold presentation of this until the spring meeting of the Association. His title was "Variable Speed Equipment and control in Sewage Treatment"; the author, H. B. Diehl, Engineer, Reeves Pulley Co., New York City.

[*NOTE.—To any interested, there is available a complete mimeographed design and operating description of the Coney Island plant which the Department of Sanitation had prepared for distribution to visitors during the plant inspection. To Messrs. Binger-Gould-Donaldson the visitors were highly indebted for arranging the trip at no expense to A.S.C.E. or N.Y.S.S.W.A.—Ed.]

THE EFFECT OF ACTIVATED CARBON ON SLUDGE DIGESTION

By C. E. KEEFER and HERMAN KRATZ, JR.
Bureau of Sewers, Baltimore, Md.

THE successful use of activated carbon at water works plants has, without doubt, stimulated an interest in the possible application of this chemical in the treatment of sewage. In May, 1935, therefore, preliminary experiments were made at the Baltimore sewage treatment plant in order to test the effects of activated carbon as an aid to digestion. The results of the initial studies were sufficiently promising to warrant continuation and amplification of the work on a more extensive scale.

The findings in these experiments, to date, indicate that powdered activated carbon when added to raw sludge aids digestion. The best results were obtained with the addition of 8 per cent of powdered carbon to the raw sludge when calculated on its content of dry volatile solids.

Previous laboratory work by Rudolfs and Trubnick[1] indicated a value of activated carbon in hastening sludge digestion. However, these investigators used quantities that would make the cost prohibitive if daily treatment were necessary. Rogers[2] has reported that activated carbon increased sludge digestion at Garden City, N. Y. This chemical has also been used at Newark, N. Y.[3], in routine plant operation.

Laboratory Procedure

Raw sludge was obtained from the mechanically cleaned preliminary settling tanks at the Baltimore sewage works. The digested sludge used was drawn from one of the heated digesters. The characteristics of the two materials are revealed in Table 1. The sludges were mixed in the ratio of two parts of the raw to one part of digested material, based on volatile solids content of each. This mixture was then put into a number of 5-gal. digestion carboys and incubated in the constant temperature digestion room at a temperature of 28° C. These carboys were divided into two groups so that the experiments could be run in duplicate. All of the reported results are averages of the two groups of tests.

The amount of activated carbon added to the carboys amounted to 2, 4, 6, 8, and 10 per cent of the dry raw volatile solids present. To one of the carboys in each group no activated carbon was added. The condition of the materials at the beginning and the close of the investigation is revealed in Table 2. It is interesting to note that the pH value of the sludge which did not receive activated carbon was 6.3, and that the larger the amount of activated carbon added, the higher was the resultant pH value. It is probable that this increase in pH value was caused by neutralization of some of the acidity and by the adsorption on the activated carbon of some of the organic acids in the sludge.

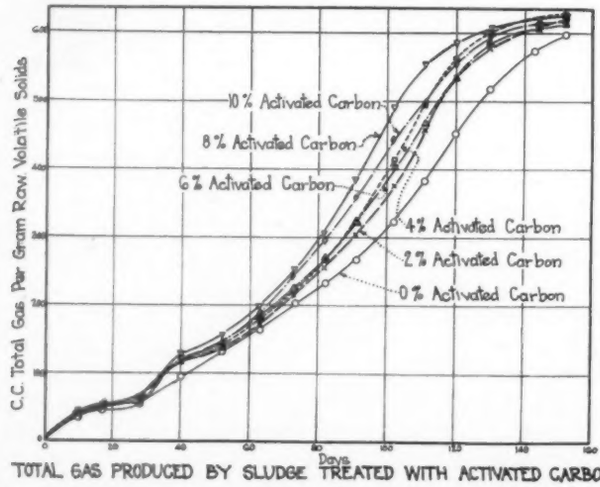

10 % Activated Carbon
8 % Activated Carbon
6 % Activated Carbon
4 % Activated Carbon
2 % Activated Carbon
0 % Activated Carbon
C.C. Total Gas Per Gram Raw Volatile Solids
Days
TOTAL GAS PRODUCED BY SLUDGE TREATED WITH ACTIVATED CARBON

Fig. 1.—Effect of Carbon in Speeding Sludge Digestion, Thereby Increasing Permissible Solids Loadings Into Digesters.

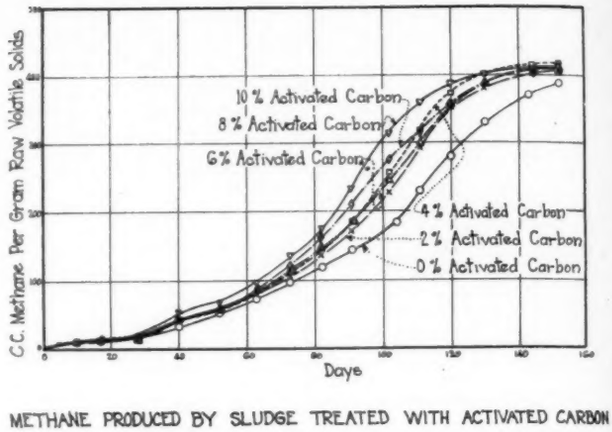

10 % Activated Carbon
8 % Activated Carbon
6 % Activated Carbon
4 % Activated Carbon
2 % Activated Carbon
0 % Activated Carbon
C.C. Methane Per Gram Raw Volatile Solids
Days
METHANE PRODUCED BY SLUDGE TREATED WITH ACTIVATED CARBON

Fig. 2.—Effect of Carbon in the Production of Gas of Higher Heat and Fuel Value.

Results

The speed of digestion was judged by the rate of gas production and total amount of gas formed; the quality of digestion, on the basis of quality of gas produced, as judged by carbon dioxide and methane content. The rate of digestion, the total quantity and the quality of gas produced is revealed graphically in Figs. 1 and 2. Gas production was most rapid from the sludge to which 8 per cent of activated carbon had been added. The

TABLE 1.—CHARACTER OF SLUDGES USED

	Solids	Volatile Matter*	pH
Raw sludge	6.8%	79.4%	7.0
Digested sludge	7.1%	55.1%	6.0

*Per cent in dry solids.

TABLE 2.—CHARACTER OF SLUDGE TREATED WITH ACTIVATED CARBON

[Before and After Digestion]

	Sludge Before Digestion (May 1, 1936)			Sludge After Digestion (Sept. 30, 1936)		
Quantity of Activated Carbon Used*	Volatile matter, dry basis	Solids	pH	Volatile matter, dry basis	Solids	pH
None	69.3%	7.0%	6.3	57.6%	5.2%	8.1
2%*	69.5%	7.0%	6.6	57.7%	5.0%	8.2
4%	69.8%	7.0%	6.7	57.9%	5.2%	8.1
6%	70.1%	7.0%	6.8	58.4%	5.1%	8.2
8%	70.3%	7.0%	6.9	58.4%	5.2%	8.0
10%	70.6%	7.0%	7.0	58.4%	5.3%	7.8

*Percentage of dry raw *volatile solids* in sludge.

next best results were obtained with the 4 and the 10 per cent additions. Even the 2 per cent addition showed beneficial effects. The sludges which did not receive activated carbon were slowest in producing gas. Moreover, the quality of the gas was the poorest. The use of 8 per cent of activated carbon reduced the time required for digestion by about 19 per cent.

The experiments indicate:

(1) That activated carbon hastens digestion and coincidentally improves the richness of the gas (heat and power value) by raising its methane content.

(2) That carbon dosages as low as 2 per cent of the dry volatile solids in the raw sludge proved beneficial.

(3) The 8 per cent additions produced maximum improvements; whereas 4 per cent produced intermediate, but noteworthy, results.*

(NOTE.—Possibly the picture may be clarified for the benefit of operators finding it difficult to evaluate the relationship between the carbon applications on the more exact basis recorded (pounds of carbon per hundred pounds of dry volatile matter in the undigested solids) and pounds of carbon used per million gallons of sewage involved. The suspended solids removed from the sewage (a strong domestic sewage) in the preliminary sedimentation tanks at Baltimore for the 5-year period from 1932 to 1936, inclusive, has averaged 120 parts per million or 1,000 pounds per million gallons. On a dry basis the average dry volatile solids content of the sludge is 91 parts per million. Therefore for Baltimore conditions the carbon dosages above amount to approximately 15 lbs./M.G. in the case of the 2 per cent application upwards to 60 lbs./M.G. for the 8 per cent application.—The Authors.)

The Baltimore sewage works, operated by the Department of Public Works, is under the general supervision of B. L. Crozier, chief engineer, and G. E. Finck, sewerage engineer. G. K. Armeling is superintendent of the main treatment plant. In the laboratory work, J. W. Bushman, junior chemist, assisted.

Acknowledgment is due the Industrial Chemical Sales Company for supplying the activated carbon used in the tests.

*Now under way are a series of experiments comparing hydrated lime and carbon. This for the purpose of studying the pH effect alone as compared to the overall effect of the carbon. Likewise, the cost of each.—C. E. K.

REFERENCES

1. W. Rudolfs and E. H. Trubnick, Sewage Works Journal, 7, 852 (1935); WATER WORKS AND SEWERAGE (digest), April, 1935, p. 123.
2. A. H. Rogers, Sewage Works Journal, 7, 691 (1935); WATER WORKS AND SEWERAGE (digest), July, 1935, p. 251.
3. T. J. Smith, WATER WORKS AND SEWERAGE, 82, 319 (1935).

▼

Dr. W. P. Mason Dies; Famed and Beloved Teacher

Dr. William Pitt Mason, widely known engineer and chemist, an authority on water supply and its purification, and of lovable personality, died in his 83rd year at his home in Little Boar's Head, N. H. For many years he was head of the Department of Chemical Engineering and Chemistry at Rensselaer Polytechnic Institute, from which he retired in 1925.

Born in New York City, he was graduated by Rensselaer as a Civil Engineer, studied under Pasteur in Paris and secured his doctor's degree in 1881. He began teaching in 1875 and 1893 became Professor of Chemistry at his alma mater. In 1908 he was honored with an LL.D. degree by Lafayette College. He was an Honorary Member and a past president of the American Water Works Association; a founder-member of the American Institute of Chemical Engineers; a member of the Chemist's Club of New York, and numerous other societies.

Dr. Mason early in his career, became a recognized leader and authority in the water supply field—both municipal and industrial—which benefited from his services through an important consulting practice. He produced well known text and reference books on water analysis, water supply and water purification.

He had an inspiring and lovable personality, in addition to his teaching ability. This combination brought to his courses some of the now leading chemical engineers and water supply authorities, whose Alma Mater is R.P.I.

Surviving Dr. Mason is his widow and one son—W. P. Mason, a New York City attorney.

▼

President of A.W.W.A. Addresses Chlorine Institute Meeting

W. W. Hurlbut

The Annual Meeting of the Chlorine Institute, Inc., held January 21st in New York City, was addressed by an honored guest speaker, Wm. W. Hurlbut, President of the American Water Works Association, who as Los Angeles' Engineer of Water Supply, had an interesting story to tell America's leading chlorine producers concerning the history and value of chlorination in protecting one of the Nation's most important water supplies. Mr. Hurlbut emphasized the far greater dependability of chlorination in modern developments, when compared to the earlier Los Angeles installations. The first city to adopt Residual Chlorinators at all important stations, Mr. Hurlbut cited the value of such equipment in dependably and economically effecting efficient chlorination under all conditions of variation in rate of draught and quality of water. Notable had been the freedom from taste complaints and chlorine waste due to sporadic over chlorination resulting from previous control, planned to preclude all possibilities of under chlorination. This "robot" of chlorinators automatically adjusted chlorine feeds to meet changing demands as indicated by changes in the residual detected by the dependable electric eye which found no reason to "sleep on the job."

The Institute Board of Direction is composed of officials from leading chlorine producers, several of which are well known in the Water and Sewage fields. Officers elected were: President, S. W. Jacobs, Vice-Pres. Electro Bleaching Gas Co.; Vice-President, E. C. Speiden, Pres., Innis, Speiden & Co.; Secretary-Treasurer, Robert T. Baldwin, The Chlorine Institute, Inc.

The Institute voted to continue and expand its cooperative experimental research in the field of water and sewage treatment under the general guidance of Linn H. Enslow, and with Harry A. Faber in active charge.

WATER TO FLOOD AREA BY TANK CAR MADE DOUBLY SAFE

By WALTER A. SAVELL

Mgr. Technical Service,
Mathieson Alkali Works, Inc. New York City

Water a-plenty to drown in, but not enough to drink. Such was the tragic situation which faced countless citizens when the Ohio River went hog-wild last month. From Wheeling to Cairo and throughout the State from which it gets its name, the raging Ohio swept everything before it. And in every community along its course that didn't actually have to be evacuated, impaired if not totally disabled water supply systems presented a

Chicago Loads Tank Cars with Safe Water for Flood Stricken Sister Communities. Each Car Received a Safety Dosage of H. T. H. During Filling

menace of water-borne disease which called for quick, concerted action to prevent complete catastrophe.

In peace-time calamity as well as in war, the American people have shown an amazing ability to pull together. The current Ohio flood emergency is no exception. Almost before the flood had bared its ugly teeth, preparations to help out fellow citizens were under way in other parts of the country. The quick action in arranging to ship safe drinking water into the flooded areas was typical of this spirit of cooperation. Railroad tank cars furnished by these firms were filled with Chicago city water by fire hose, and transportation facilities were strained to insure quick delivery of the water to suffering cities and towns.

In order to insure arrival of the water in safe condition, the tank cars were first thoroughly cleaned. Then, as each car was filled, enough dry "H T H" was added to give the water a residual of available chlorine of 0.75 p.p.m. This entailed the use of only 2 ounces (or thereabout) of "H T H" for each 8,000-gallon car. Although the city water was of the highest test, this precaution was deemed essential by Chicago's Division of Water Safety Control to guard against the possibility of contamination in transit. And this Division took the responsibility of having a man on hand wherever cars were being filled to see that this precaution was taken.

In addition to facilitating safe shipment of water by tank car, "H T H" has also proved itself a quick and effective aid in the solution of numerous other water purification problems which had to be met during the current emergency. In many cities where power was shut off and regular chlorination was impossible, "H T H" was fed by auxiliary hypo-chlorinating equipment. In others where pollution from flood waters created a demand which existing equipment could not meet or where wells and small supplies were contaminated, it again stepped into the breach. To meet the enormous demand for chlorine in this form, emergency shipments of "H T H" were rushed into the stricken area by every remaining means of transportation, including aeroplanes.

It is superfluous to mention that flood emergencies like that which occurred in the Spring of 1936, and that from which many are just recovering, place on water works officials a grave responsibility for their community's health. In their program of preparedness, a stock of a stable, concentrated chlorine carrier, such as "H T H," has proved a useful and dependable ally.

▼

A Sprinkling Filter That "Could Take It"

This interesting picture came from Oscar Ward, Chief Operator at the Marshfield, Wisconsin, sewage treatment works (Member Central States Sewage Works Association), who makes the following comments: This photograph was taken after six weeks of 1936 winter, during which time temperatures fluctuated between zero

The Marshfield, Wis., Filters—Winter of 1936

and 36 *below*. By actual measurement these ice mounds were 4 feet high. The most interesting part of the story is contained in Mr. Ward's operating records which reveal the following average B.O.D. values for the period: Raw = 210; Settled = 145; Filter Effluent = 40. Considering the fact that the secondary settling tanks were out of service during the period, and sustained temperatures were never above zero, the record is the more remarkable.

PRACTICAL ELECTRICITY IN THE PLANT

The ABC's of Electricity for the Water and Sewage Works Man—Article No. 3 of a Series

By MARSDEN C. SMITH

Engr., Water and Electricity, Dept. Public Utilities, Richmond, Virginia

The Author

FUSES and all electrical circuit-breakers are similar in function to the safety valve on a boiler; and hence they should be seriously considered. They are all intended to open the circuit, thus stopping the flow of current, should the current exceed a predetermined or dangerous rate of discharge through these safety devices.

While the problem of circuit protection becomes at times quite involved, still there is much that can here be discussed to advantage. In the first place the National Electric Code is now almost universally accepted as the authority for the safe utilization of electricity in all except central station systems. Consequently the engineer should obtain a copy of this useful and important publication.

Fuses and Circuit Breakers

Fuses are the cheapest and simplest of all protective devices. They consist of a piece of relatively high resistance alloy wire or tape, designed to melt, and thereby part, at the current at which the fuse is rated. The wire is enclosed in a suitable flame proof case to prevent ignition of surrounding materials at the time the fuse flashes and melts. The use of fuses is now confined almost entirely to circuits, the importance of which do not justify the more expensive and accurate devices. The type now approved known as the "refillable type" permits the renewal of the fuse link, using the expensive part (the cartridge) over and over again.

For those applications in which the replacement of fuses is frequently necessary, thermal relays or air circuit breakers are to be recommended. Motor circuits fall in this classification. Thermal relays and circuit breakers can permit a greater than rated current pass for a short time, as during the starting period of a motor, and therefore are of especial advantage for this service. The current capacity as well as the voltage ratings of this class of protective devices are limited, and when greater limits are needed, the oil circuit breaker must be used.

The oil used in circuit breakers must be especially selected for this service; and, no other oil should ever be used. This precaution is essential for the reason that the oil must have high insulation value, high flash point, low carbon content and wide temperature viscosity constant—all, in order to quickly quench the arc that is formed with each opening of the contacts.

Relays

The overload operation of an oil circuit breaker is usually actuated by an auxiliary device known as a relay. Relays may be of several types: the instantaneous, the inverse time limit, and others. The modern relays are truly marvelous devices; however, the types needed by the water works plant are, in the main:

1) *The Instantaneous Type*—dash-potted relays, with direct mechanical trip. Here a coil which carries all or a definite part of the load current raises a solenoid when the current flow exceeds a predetermined value. The rising solenoid mechanically releases a trigger, which in turn permits the oil circuit breaker to open. An oil filled dash-pot retards the solenoid movement. The dash-pot opening is adjustable, hence the time for opening with a given over-current can be selected as desired. The oil in the dash-pot should be inspected at intervals and replaced if dirt or sludge has accumulated. While rather crude, this device is sufficiently accurate for the protection of most small motor circuits.

2) *The Air Bellows Type.* This type is not much used now. An air bellows, with an adjustable escape valve, is substituted for the oil dash-pot described above.

3) *The Induction Type.* This relay is more expensive than those above mentioned, but its use is justified in the protection of all important circuits.

With the induction relay, when the current exceeds the desired value, the torque on an aluminum disc, mounted on the same shaft with the relay contacts, causing the shaft to rotate. Such rotation causes the opening (some cases the closing) of the relay contacts, which in turn electrically energize the main tripping coil on the circuit breaker. The advantage of this type is that the time of opening the main circuit breaker can be determined to a fraction of a second; also, that the limits of control are so wide that these relays, with suitable current transformers, become almost universally applicable and highly accurate protective devices.

To repeat, too much care cannot be given the subject of circuit protection. Over-fusing (use of fuses with too great capacity) of circuits is dangerous and uneconomical. Noting a too frequent operation of the overload protection of any appliance warrants prompt investigation. The source of the trouble should be remedied by correction, rather than following the easiest path of using too large circuit protection to overcome an annoying operating circumstance.

Grounding—Its Essentiality

It is no exaggeration to say that without adequate grounding, satisfactory electrical service would be virtually unknown. In addition, safety would be a word more than a reality. Even so, many groundings are so deficient in quality as to become actually a hazard instead of a safety effect. Many persons have been swindled into paying for a false sense of security when installing lightning rods having many ornamental glass balls but no grounds. Thereby, the victim is actually inviting lightning to strike the house but offering no protection by way of a cable or rod to conduct the electric discharge into the earth and there dissipate it.

Grounds should be carefully made. Use not less than

No. 2 B&S gauge copper wire. Several grounds are preferable to a single ground in order to lessen the chances of broken connections. Use the water pipe system, the larger the pipe the better. Do not use the gas, gasoline or oil pipe lines. Be sure the connection between the wire and pipe is electrically and mechanically as perfect as possible. If no pipe system is available, drive at least three 1¼ inch pipe, or equivalent copper rods *well below the moisture line* in the earth. A good test is that the driven ground connection, when shorted, should blow a 30 ampere fuse at 120 volts.

Much discussion has recently been raised in the water works field as to the effects of attaching the electric circuit "neutral" wires to the water pipes. There is no question that the damage done to water systems by stray direct currents, as from street railways, has been indeed enormous. Here we have electrolysis at its worst, and the destruction of the metallic pipes at spots where the current leaves the pipes is rapid. This condition is inexcusable and should be prohibited everywhere.

However, in the alternating current system the damage is not so evident, and many doubt its *real* existence —or at least its seriousness. Also it is quite possible that were all connections between electrical and water systems removed, electrical service as we know it today would be a thing of the past. And even should such action force the electric companies to seek other means of obtaining the necessary protection now provided by these grounding attachments, the water systems would be subject to the same distress now *debatedly* suffered. It would seem certain that more severe difficulties would be caused by the same currents finding their way to the water system in a then uncontrolled routing and dissipation which present practices have been designed to effect.

The necessity for grounding the electric circuits is to prevent dangerous high-potential voltages (through mistakes or accidental contact) from increasing the normally low-potential circuits to a dangerous loading. The wiring for lighting systems of buildings is designed for a maximum of 150 volts to ground. Let us assume that a street series circuit operating at 5,000 volts should fall across the service wires from the pole to your home. With no ground on the "neutral" of your secondary wiring, its potential would be raised from its normal low value to a maximum of 5,000 volts. Certainly something must happen; either a fire is started or perhaps a member of your family may be killed. The effect of such danger has been observed when service thawing current reaches the house wiring. In these instances the "ground" has worked in reverse but proves its safety value, and the necessity of "breaking" the service line before electrical thawing is started. Now consider these same conditions to exist except that now your "neutral" is properly grounded. When the high potential circuit is now temporarily crossed with service, the high potential currents are safely carried to ground, and no one in the home would realize the possible disaster that the ground connections have avoided.

When, What and Why Ground?

There is no doubt that a full study and discussion of the entire subject of grounding by the new functioning joint committee will prove well worth while. It is certainly to be hoped that there will result a greater care in the preparation and arrangement of ground connections between the electric and water systems, and that the volume of current flow be intelligently regulated. We, the water utility interests, should not embarrass this effort by hasty demands to prohibit all grounding to the water systems. As a matter of fact, we could not do so even if thoughtless enough to demand such.

[Water works men have, themselves, found difficulty in effectively grounding pumping station motor circuits by any other method than an efficient connection to their own pressure mains leaving the station.—Ed.]

No wires used in lighting systems should have more than 150 volts to ground. The wires of power circuits, such as 220 or 440 volts, *should not be grounded.* All appliances, frames of motors, conduit, etc., in addition to the "neutrals" of lighting systems, should be carefully and effectively grounded. Inspect grounds frequently. The snuffing out of a life may be the penalty if you do not. Satisfactory operation is another, if secondary, reason for so doing.

▼

"Gene" Dugger Next President A.W.W.A.

E. F. Dugger

In annual meeting January 20th, in New York City, the Board of Direction of the American Water Works Association chose Eugene F. Dugger as its nominee for presidency of the association. In the absence of a nominee at large, he assumes office with the closing of the next Annual Convention—June 12th, at Buffalo, N. Y.

Mr. Dugger is General Manager of the Newport News (Va.) Water Commission. Since 1924 he has been an active member of the association. He was an ardent and successful advocate of the Virginia Water and Sewage Works Association (which he served as president) becoming the Virginia Section of A.W.W.A. When that happened he was honored by being elected as the first Virginia representative on the National Board of Direction of A.W.W.A.

During his term as A.W.W.A. director, Mr. Dugger proved a consistent worker and, therewith, rendered valuable service and action. In his retiring year as "the director from the State of Presidents" it is timely that his services are to be extended and enlarged through an administration as its president—and, thereby, No. 1 director of the association.

"Gene" Dugger first became known to the water works profession for his accomplishments as "that young, energetic and efficient engineer-manager of the Newport News Water Works." His success as such is measured by the physical and financial condition of the water utility he heads.

To him, and to A.W.W.A., we say: May his administration in A.W.W.A. be as successful and productive of betterments and strength, as has his management of the water utility in the city he serves.

▼

ILLINOIS STATE UTILITIES SALES TAX VOID—The Illinois state utilities sales tax, companion law of the 3 per cent occupational (sales) tax, imposing a 3 per cent tax on commercial and domestic business of water, power, gas and telephone companies has been held unconstitutional by the Illinois Supreme Court. The ruling will deprive the state of more than $500,000 a month, or one-sixth of the $3,000,000 monthly sales tax revenues.

COAGULATION

Effect of Silicon on Aluminum Hydroxide Coagulation

By JOHN R. BAYLIS*
Associate Editor

METHODS of conducting the coagulation experiments, and some information on the influence of silicates on the coagulation of water were given in the December, 1936, issue of this magazine. This data showed that silicate solutions applied to samples of water greatly increase the rate of coagulation with aluminum sulfate when the resultant pH is between 6.0 and 7.0. It also showed the effect of varying the amount of silicate used. The present article is a continuation of the discussion of the silicate effect on aluminum hydroxide coagulation.

Effect of Varying the Concentration of Aluminum Sulfate

Increasing the concentration of coagulating substances in water increases the rate of floc formation, providing conditions are favorable after the addition of the coagulant. Where the amount of aluminum sulfate required to coagulate the suspended matter in water is above about 30 p.p.m., coagulation usually takes place with less than 30 minutes of stirring if the water is at the pH of most rapid coagulation. Stirring or mixing for longer periods may improve the flocculation so that it will settle more rapidly, yet the solution probably will not filter clearer as a result of the prolonged agitation. The use of something to hasten flocculation therefore is more attractive in plants when the water is least turbid. It also may be useful in certain waters where the turbidity in the water is intermittently or continuously difficult to coagulate.

The addition of silicates to samples of prepared distilled water shortens the time required to form coagulation. This was shown to be so in the previous article of this series. Table 5 gives the effect of varying the amount of aluminum sulfate on time required to form coagulation at pH close to 6.7, and Table 6 gives the effect of varying both the aluminum sulfate and silicate. The line in Figure 3, for no silica, is plotting of the time of stirring required to form an excellent coagulation (see Table 5). It shows that when the amount of aluminum sulfate is above about 20 p.p.m. the time of stirring need not be very long for water with the pH at which the tests were made. The other line in Figure 3, where silicate was used, is plotting of the results given in Table 6 for excellent coagulation where the Sio_2 equivalent was 40 per cent of the amount of aluminum sulfate used. The line may not be exact for amounts of aluminum sulfate less than 10 p.p.m., for 4.0 p.p.m. of SiO_2 was the lowest amount used in the tests. For this particular solution, the ratio of 4 for silicon to 10 for aluminum sulfate gave good results.

The quantities of silicate are given in parts per million of SiO_2. This should not convey the impression that the silicon compound which aids coagulation occurs in the form of silicon dioxide (SiO_2). It is merely the form in which the silicon is determined through gravimetric analyses to determine the amount of silicon in the solution. To determine the amount of silicon in a solution a portion of the solution was made acid with hydrochloric acid, evaporated to dryness, washed thoroughly, and heated to high temperature in the muffle furnace. Where great accuracy was not necessary the silicon was not driven off by the use of hydrofluoric acid as is the customary practice for silica (SiO_2) determinations.

TABLE 5.—EFFECT OF THE AMOUNT OF ALUMINUM SULFATE ON RATE OF COAGULATION.
Distilled Water with Calcium Carbonate Added.
(Turbidity 30; Temperature 25° C.)

Test No.	Aluminum Sulfate P.P.M.	pH 5 Min.	pH 30 Min.	pH 75 Min.	Alkalinity at End of Test	Turbidity After Filtering
1.....	10	6.8	6.8	6.9	20	0.0
2.....	15	6.8	6.8	...	20	0.0
3.....	20	6.8	...	...	20	0.0
4.....	30	6.7	...	...	22	0.0
5.....	40	6.6	...	...	22	0.0
6.....	60	6.6	...	...	22	0.0

Test No.	Minutes Stirring Required to Form Coagulation: Just Vsiible	Small Particles	Fairly Good	Good	Excellent
1.....	40	50	60	75	..
2.....	17	20	22	25	30
3.....	8	10	11	12	14
4.....	6	7.5	8	8.5	9
5.....	4	5	6	7	7.5
6.....	2	2.5	3	4	5

The data illustrated in Figure 3 give comparison of samples of artificial waters, prepared distilled water, and are not typical for natural waters. There would not have been such a wide difference in the lines had the comparison been made on a natural water, unless it was some unusual water containing something which made coagulation difficult. As all natural waters probably contain some silicates, or SiO_2 in solution, a line for coagulation in the average natural water should be nearer the line obtained when silicate was used. There may not be a single natural water where a material saving in the amount of aluminum sulfate required to properly coagulate the water may be made by the addition of silicate, though it seems probable that there should be at least a few. The chief benefit in using this substance is to shorten the time required to coagulate the water. Another benefit is that the coagulated material settles rapidly. In some instances this may be of particular advantage.

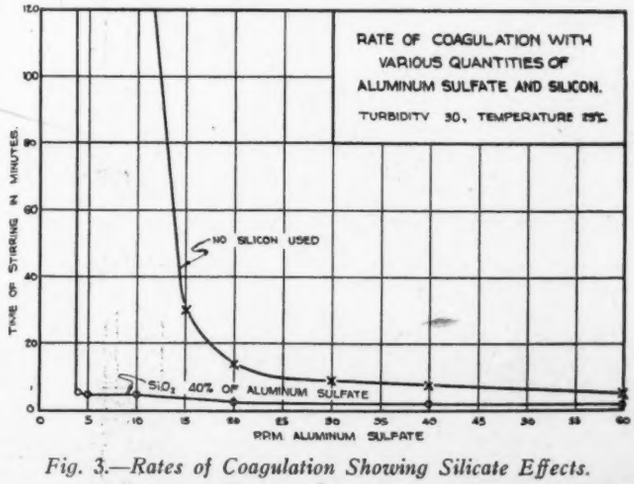

RATE OF COAGULATION WITH VARIOUS QUANTITIES OF ALUMINUM SULFATE AND SILICON.
TURBIDITY 30, TEMPERATURE 25°C.
NO SILICON USED
SiO2 40% OF ALUMINUM SULFATE
TIME OF STIRRING IN MINUTES.
P.P.M. ALUMINUM SULFATE

Fig. 3.—Rates of Coagulation Showing Silicate Effects.

*Physical Chemist, Division of Water Purification, Department of Public Works, City of Chicago.

TABLE 6.—EFFECT OF CONCENTRATION OF SILICA AND ALUMINUM SULFATE ON RATE OF COAGULATION.

(The source of Silicon being a carbonated solution of sodium silicate.)

(Turbidtiy 30; Temperature 25° C.)

Test No.	Aluminum Sulfate P.P.M.	SiO_2 P.P.M.	pH	Alkalinity at End of Test	Turbidity After Filtering
1.....	3	4	6.4	22	0.6
2.....	4	4	6.4	20	0.0
3.....	5	4	6.4	22	0.0
4.....	10	4	6.4	22	0.0
5.....	15	4	6.4	23	0.0
6.....	20	4	6.6	23	0.0
7.....	20	8	6.4	28	0.0
8.....	30	4	6.4	22	0.0
9.....	30	8	6.5	26	0.0
10.....	40	4	6.4	22	0.0
11.....	40	16	6.4	24	0.0
12.....	60	4	6.4	20	0.0
13.....	60	24	6.0	12	0.0

Test No.	Minutes Stirring Required to Form Coagulation: Just Visible	Small Particles	Fairly Good	Good	Excellent	Immense
1.....	15	20	25	40	(No further change)	
2.....	3.5	4	4.5	5	5.5	7
3.....	2.5	3	3.5	4	4.7	6
4.....	2.5	3	3.5	4	4.5	5.5
5.....	2.5	3	4	5	5.7	7.5
6.....	6	6.5	7.5	8	8.5	12.5
7.....	1.7	1.9	2.1	2.3	2.5	3.3
8.....	7	7.5	8	8.5	9.5	...
9.....	2.2	2.5	2.8	3.1	3.5	5.0
10.....	5	5.5	6	7	7.5	...
11.....	1.0	1.2	1.5	1.7	2.0	2.8
12.....	3	3.3	3.7	4	5	...
13.....	0.7	0.8	1.0	1.5	2.0	...

Some Difficulties Overcome

Considerable difficulty was experienced at first in the preparation of the solutions of silicate. Most of the early solutions prepared did not give good results on the Lake Michigan water. For a time it seemed that this would be an obstacle not easily overcome. Preparation of suitable silica solutions will be discussed in another article, though it may be well to state that most of the difficulties at first encountered have been overcome and solutions can now be prepared which offer considerable aid to coagulation in natural waters as well as in artificially prepared waters. This statement applies to the use of ferrous sulfate as well as aluminum sulfate.

Appearance of Coagulation

Silicate not alone hastens the time required to form a good flocculation of the aluminum hydroxide, but it builds up large particles which settle rapidly. The number of coagulated particles in a given volume of water coagulated without the aid of silicate is much greater than the number in water treated with it. In consequence, the individual particles in the silicate treated water are larger. This, of course, is an advantage, and is the purpose of prolonged mixing and the use of flocculation effects in water filtration plants.

Photomicrographs of the precipitated floc are shown in Figure 4. The photomicrograph on the left is coagulated matter from the mixing basin of the Chicago Experimental Filtration Plant, in which 11 p.p.m. of aluminum sulfate was used. The one in the center is Lake Michigan water coagulated in the laboratory on the same date the sample was taken from the plant mixing basin. Ten p.p.m. of aluminum sulfate was the dosage used. The photomicrograph on the right is silicate treated water in which 10 p.p.m. of aluminum sulfate and 4 p.p.m. of SiO_2 in the form of silicate were used. In this instance many of the coagulated particles were too large to be photographed with the magnification of the microscope which was used. The dim lines show the magnification, each square having sides approximately 0.58 mm. in length.

To obtain the coagulation for photographing, petri dishes were placed in the bottom of one-liter beakers. The coagulated matter was allowed to settle into the dishes, then the dishes were removed, taking care not to wash the sediment from them while they were being removed. The dishes then were tilted slightly and moved slowly so as to cause a slight rotating motion of the water. The purpose was to compact the coagulated particles to a certain extent. The photomicrograph on the left in Figure 4 shows that there was little compacting of the particles by the extra agitation, due probably to their small size. The center photomicrograph shows the particles to be more compact than those from the plant mixing basin, probably because the laboratory stirrers produced a better formed coagulation. Neither the plant mixing basin nor the laboratory stirring machine produced such large flocculated particles without silica as were produced in the laboratory with silica treated water.

Silica Increases Adhesiveness

There is evidence that silica increases the adhesiveness

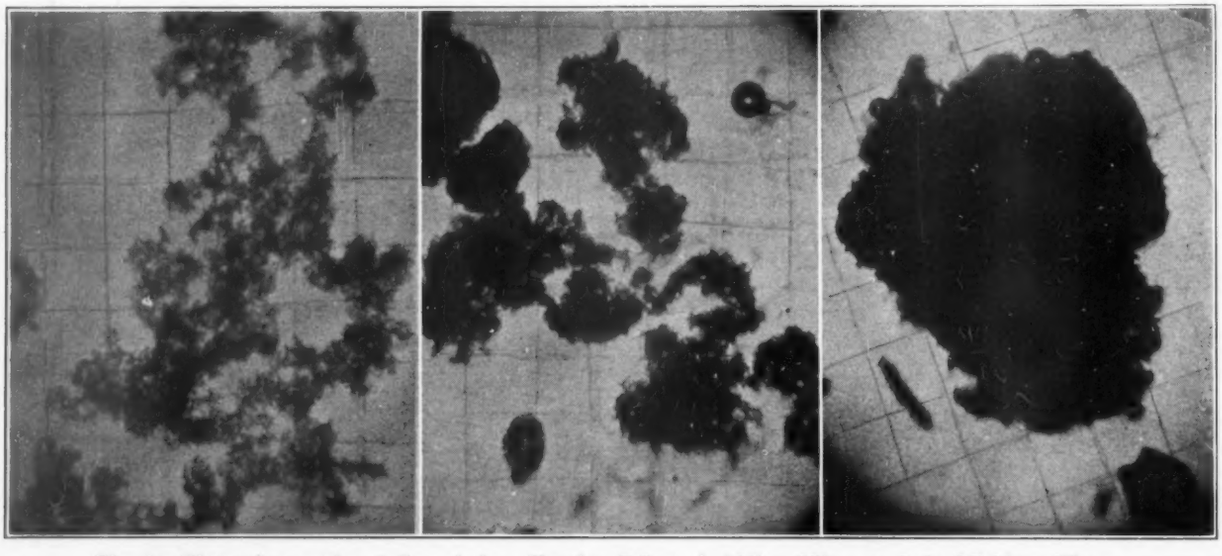
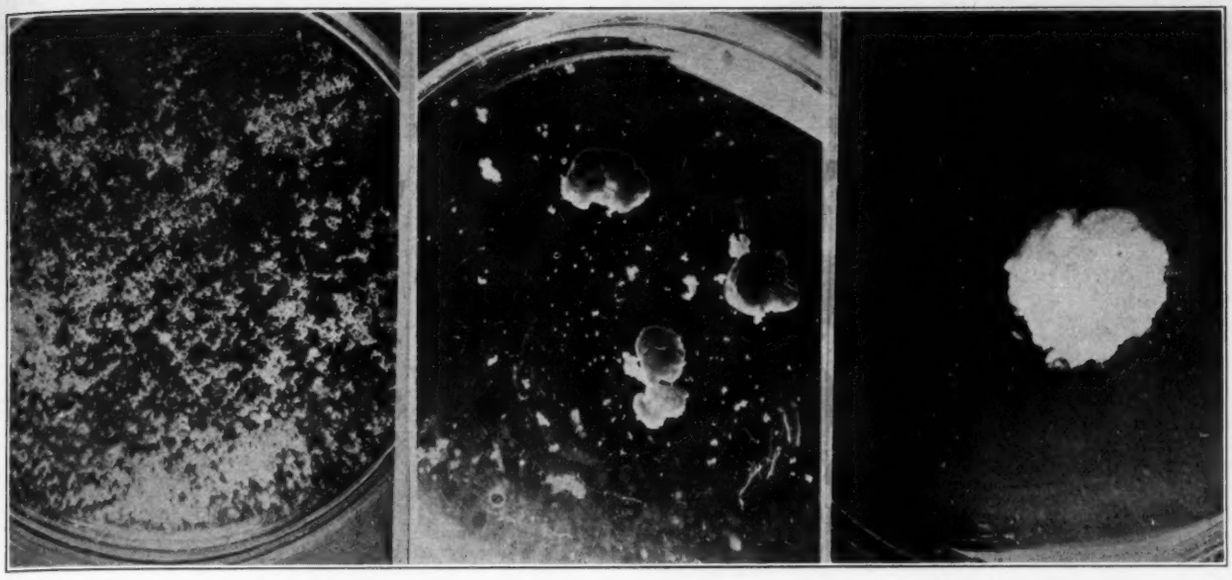


Fig. 4.—Photomicrographs of Coagulation, Showing Effect of Adding Silicon to Lake Michigan Water.

From Plant Mixing Basin; No Silica Used. | *Coagulated in Laboratory; No Silica Used.* | *Coagulated in Laboratory; 4.0 p.p.m. SiO_2 Used.*



No Silicon 4.0 *p.p.m.* SiO_2 4.4 *p.p.m.* SiO_2

Fig. 5.—*Effects of Silica on Aluminum Hydroxide Coagulation, Using Lake Michigan Water.*
(The above illustrations show true size of the floc particles, being exact reproductions of photographs made to exact size.—Ed.)

of the coagulated particles and causes them to be joined together into larger masses. The coagulated particles may, in fact, be rolled up on the bottom of the beaker or petri dish ot the extent that all of the coagulated matter is rolled into one large ball. These balls may be of considerable size. The photographs in Figure 5 are practically natural size. The one on the left is Lake Michigan water coagulated in the laboratory with 10 p.p.m. of aluminum sulfate and no silicate. The balled-up coagulation in the center photograph was produced with 10 p.p.m. of aluminum sulfate and 4 p.p.m. of SiO_2. Some of the finer coagulated particles which settled after most of the coagulated matter had been rolled into balls show in the photograph. All of this could have been rolled into the balls had they been rolled over the bottom after all of the particles had settled. The large ball of precipitated floc in the photograph on the right was practically all of that produced in one liter of water with 10 p.p.m. of aluminum sulfate and 4.4 p.p.m. of SiO_2. The ball was mashed slightly in the petri dish, but when almost round was slightly over three-fourths of an inch in diameter. Surely there must be considerable adhesiveness for the particles to stick together so firmly.

Additional proof that silica adds to the adhesiveness of the coagulated particles is given by the tests in Table 7. Solutions were prepared from distilled water containing a calcium carbonate alkalinity of 25 and turbidity of 30. The stirrers were started, and 10 p.p.m. of aluminum sulfate added to each solution. Measured portions of a solution prepared by diluting silicon tetrachloride with water were added to the solutions at various intervals after the aluminum sulfate. Enough of the silicon solution was added to give 0.25 p.p.m. of SiO_2. This amount of silica, added two minutes after the aluminum sulfate, formed a coagulation composed of very small particles within 2 hours, and there was no further improvement in the coagulation by continued stirring. A solution containing no silica formed a coagulation which was just visible within two hours, then when 0.25 p.p.m. of SiO_2 was added an excellent coagulation was formed within 10 minutes. Continued stirring of a solution with no silica did not improve the coagulation after two hours. This small amount of silica was sufficient to cause the very small coagulated particles to adhere together into large flocculated masses.

(Discussion of the effect of silica compounds on coagulation will be continued in the next article in this series.)

TABLE 7.—EFFECT OF ADDING A SILICON COMPOUND AFTER THE ALUMINUM SULFATE.

The solutions were prepared from distilled water and contained 25 p.p.m. of calcium carbonate and turbidity of 30.
(10 p.p.m. Aluminum Sulfate; Temperature 23° C.)
0.25 p.p.m. SiO_2 (from solution of silicon tetrachloride) was added.

Test No.	pH	Time After Adding Aluminum Sulfate Before Adding Silica (Minutes)	Condition of Coagulation Just Before Adding Silica	Minutes Required to Form Coagulation After Addition of Silica — Just Visible	Fine Particles	Fairly Good	Good	Excellent
1	6.3	2	None	68	120	..	...	..
2	6.4	10	None	50	60	90	110	..
3	6.4	60	None	5	15	20	25	40
4	6.4	120	Just Visible	0	3	5	7	10

SEWAGE TREATMENT DESIGNED TO HANDLE INDUSTRY'S WASTES

By C. C. HOMMON*
Canton, O.

How a Small Town Cares for the Wastes of Its Industries—And Gets Paid for the Service

ORRVILLE, Ohio, is a small municipality of approximately 4,400 persons, located on the Pennsylvania Railroad in Wayne County. It is a thriving and well administered municipality and has a number of diversified industries. The village's utilities consist of a water works, sewage treatment plant, power and light, and ice plant, all operated under the general direction of the Board of Public Affairs and under the personal supervision of Superintendent A. D. Webster.

The Author

Among the several industrial plants located within the village and three sizeable milk processing plants, a slaughter house and a food processing plant making apple butter and preserves of various kinds. All of the industrial wastes from these plants enter Orrville's sanitary sewer system and are therefore involved in the sewage treatment program.

The absence of a sizeable steam and the consequent light dilution afforded renders proper disposal of sanitary sewage and industrial wastes a difficult problem in this municipality.

The treatment of sewage in Orrville was first attempted in 1908. The plant consisted of a septic tank, 0.5-acre contact beds, followed by 1 acre of sand filters, discharging the treated sewage into Little Chippewa Creek, a very small water-way that has but little or no water in it for the greater part of the summer season. Such a plant was capable of properly treating sanitary sewage, but soon after being placed in service, industrial wastes began to offer complications.

The high degree of treatment required and the very strong character of the sewage, and perhaps the lack of intelligent and proper operation, caused the plant at different times to be in ill repute. In 1923 major repairs were made. A screen chamber was added to the plant, the contact filtering material was renewed and the sand filters were reconditioned and some new sand was provided. These repairs provided only temporary relief and soon the receiving stream was again being grossly polluted. In 1932 a number of riparian property owners along the stream below the sewage plant filed suits against the village for damages. The Village Council, appreciating their responsibility, authorized the preparation of plans and the construction of a new sewage plant.

*Supt. Sewage Treatment Works, Canton, Ohio; Supervising Operator, Orrville, Ohio.

The new plant consists of sedimentation with mechanical removal of sludge, separate sludge digestion and two acres of sand filters. The sludge is disposed of by pumping from digester onto farm land where it is allowed to dry and is then plowed under and used as fertilizer. Ferric chloride is used as a coagulant to assist sedimentation when required, which is mostly during the summer months and at times of flush milk season.

All salvageable units of the old plant were retained in the revamping program. Of the two old septic tanks, one was converted into a three compartment sedimentation tank and equipped for mechanical sludge removal. The other unit was used as a sludge digester. No proper use could be found for the old contact beds so they were abandoned. The one acre of sand filter was reconditioned and some new sand added and an additional acre was provided.

Seasonal Chemical Precipitation Incorporated

The only novel feature in connection with the operation of the Orrville sewage plant is the use of a coagulant for conditioning the sewage to permit of higher rates on the sand filters. An appreciable amount of acreage surrounding the sewage plant is peculiar in character. It is very porous, black in color, light in weight and is often referred to as muck land. During the time of construction it was necessary to by-pass the old sewage works to permit of the improvements, and it was not advisable to turn the raw sewage into the creek. In the way of an experiment some old 3-in. pipes were laid on top of the ground and fitted with standard sprinkler sewage nozzles forrowed from the Akron sewage works, the nozzles being placed some 20 ft. apart. Through a small pump the raw sewage was sprayed onto this muck land and to everyone's surprise it absorbed great quantities of the sewage without becoming clogged or water logged. Since the plant has been completed, we have not forgotten this inexpensive and most satisfactory way of getting rid of sewage. If for any reason it is desired to lighten the load on the existing sewage works, a pump which has been installed for that purpose is started and raw sewage applied to the acreage direct. It helps in two ways, first by getting rid of some undesirable sewage at practically no cost or effort and at the same time the organic content of the sewage is building up the fertility of the soil.

At the time of design, the use of a coagulant was contemplated, but it was then decided to postpone chemical treatment until determining what improved sedimentation and proper operation would accomplish without the aid of chemicals. It was soon found, how-

ever, that the industrial load was too great for the sand units and chemicals had to be resorted to with the first rush of the milk season.

Industrial Wastes Handled

There are three milk processing plants discharging their wastes into the sanitary sewer system, namely the Orrville Milk Condensing Company, the Cottage Creamery and the Smith Dairy. The condensing company's daily milk intake ranges from a minimum of 100,000 pounds to 200,000 pounds and their sanitary wastes at flush seasons run as much as 20,000 gallons in fifteen hours Analysis of composite samples of their wastes during times of heavy runs indicates a five day B.O.D. or 1,200 ppm. The operations of Cottage Creamery and Smith Dairy are somewhat less, with correspondingly less industrial flows. The cream intake at the Cottage Creamery for an average summer month was said to be approximately 16,000 pounds daily or 30 per cent cream, and that of the Smith Dairy was estimated at about 9,000 pounds of raw milk daily. The liquid wastes from these two plants as indicated by wier measurements is about 13,000 gallons daily each. Analysis of composite samples from these two plants indicates a marked difference in the amount of milk products contained in the wastes, the former having a B.O.D. of 1,420 ppm. and the latter a B.O.D. of less than 300 ppm.

The slaughter house wastes are not large in volume, but are subject to wide fluctuations, however. The average volume amounts to approximately 3,600 gallons daily and has a B.O.D. of approximately 650 ppm. The wastes from the food processing plant are substantial, amounting to approximately 21,000 gallons daily and have a B.O.D. requirement of 600 ppm. The management states that approximately 24,000 pounds of apple butter and 10,000 pounds of preserves are manufactured daily.

The Village of Orrville has a fairly complete system of sanitary sewers, faulty, however, in the sense that at times of heavy rainfall appreciable amounts of storm water get into the system and causes the sewage flow to fluctuate within wide limits. The relatively heavy variable industrial load, together with infiltration water, cause great fluctuations in both the character and volume of sewage at the treatment plant. The average dry weather flow is estimated at approximately 275,000 gallons daily, the minimum dropping as low as 240,000 gallons daily and the maximum going as high as 1.5 million gallons daily during the excessive wet weather. At times of excessive flows, the sand filters are by-passed and that portion of the raw sewage given tank treatment that can be conveniently cared for. This is not thought to be a grievous matter for the reason that during and after local storms there is always ample water in the creek for adequate dilution.

Coagulation Crude But Effective

The reasons above referred to naturally cause excessive variation in the strength of raw sewage. Composite samples of the raw sewage collected over periods of working activities of the industries indicate an average suspended matter content of 420 ppm. and a five day B.O.D. requirement of 720 ppm. Realizing that plain sedimentation is not particularly effective in treating such industrial wastes, it necessarily followed that clogging of the sand filters would result.

As soon as this fact was definitely established, coagulation of the raw sewage was begun. The first attempt was the use of lime and ferrous sulphate which reacted quite well, but it was found that at times of excessive milk loads it was difficult to control the dosage of chemical. After experimenting with a number of coagulants, it was concluded that ferric-chloride alone did the trick nicely, and with much less attention. For the past year anhydrous ferric chloride has been used in admittedly crude fashion. The procedure consists of simply dissolving 40 pounds of anhydrous salt in 50 gallons of water in an earthern container, and by means of a small rubber tubing and a screw pinch cock, sufficient chemical is added to the sewage through a manhole ahead of the plant to give a good flock. Because of the almost momentary change in the character of the sewage, it is necessary that one person be in constant attendance during the time that addition of chemical is required, which covers the operating hours of the industry. During the summer months and the active milk season, chemical is added from about 7:30 a. m. to 11 p. m. For the past season, the amount of ferric chloride used has amounted to approximately 3.3 grains per gallon. It is fully appreciated that full value of the chemical has not been realized because of the inefficient manner of application. In consequence, plans are now under consideration for improving this phase of treatment. A flash mixing of the chemicals with the sewage has been tried with a marked degree of success. The mixing device simply consisting of churning the sewage by means of a small wooden block fastened onto the end of shaft rotated at 1,200 r.p.m. by a one-quarter horsepower motor.

Results Attained

When considering the crudeness of an operation, one must consider the cost of improvements and the results to be accomplished as a result of the proposed improvements. In this instance what appears to be inefficient practice is resulting in such efficiencies in results attained that one is tempted to let well enough alone. The suspended matter content of the raw sewage averages 419 ppm., that of the tank effluent 84 ppm. and sand filter effluent contains less than 15 ppm. This results in a tank efficiency of 80 per cent and over all removal of suspended matter of 97 per cent. As another measure of plant efficiency, the raw sewage has a five day B.O.D. of 745 ppm., which is reduced through the sedimentation tanks to 325 ppm. and through the sand filters to less than 10 ppm. On the percentage basis, the coagulation and sedimentation is removing only 56.5 per cent of the B.O.D., but the overall efficiency is 99 per cent. The interesting and practical phase of this seemingly low chemical preponderance is that the sand filters have operated this season at a rate of approximately 115,000 gallons per acre per day without cleaning with the exception of a few spots, and these were largely caused by improper distribution. The greatest labor on the filters has been keeping them free of grass and weeds.

Perhaps the best reflection as to the performance of the sewage plant is in the character of the receiving stream of water. As previously noted, Little Chippewa Creek is virtually a dry stream during the summer months and numerous inspections as well as many analyses of the stream water indicate it to be in good condition. The property owners who at one time were most bitter about the befouling of the stream with the city's sewage are quite well satisfied with present condition.

Operating Costs and Financing

The cost of operating the Orrville sewage plant for the past year amounted to approximately $5,000 and there are estimated 4,400 persons contributory to the plant. This results in a per capita cost of $1.14, which would be considerably less if population equivalents of the industrial wastes were taken into consideration.

With the building of the existing sewage plant, the Village of Orrville adopted and placed into operation the sewer rental law as a means of financing not only the operation of the plant but retiring the capital charges. Including $2,000 annual bond liquidation, makes total debt charges of $3,444 for 1936, or 78 cents per capita unit cost for this item.

The assessments on sewer users were based upon the quarterly water consumption as determined by water meter readings. The minimum charge was set at $4.44 per year for residential dwellings. It was agreed that all industrial wastes be charged for on the population equivalent basis as determined by B.O.D. determinations and measured flows. Industry is billed monthly.

To establish the population equivalents for the industrial wastes a series of composite samples were collected from the sanitary sewers of the different industries and at the same time improvised wiers were installed in the sewers in an attempt to at least approximately arrive at the volume of flows from the respective industries. From this data an equitable charge was computed. All of the rates are estimated by the municipality, and the sewage being a difficult one to treat, with resulting costs not definitely known, the industrial rates are considered as temporary and subject to change as cost of treatment becomes more stabilized. For the past year, the municipality collected through the sewer rental law $8,288.68, of which industrial establishments paid $2,593.31, or 31.3 per cent.

It is a pleasure to say that it has been possible to secure the closest of harmony between the several industries and the city officials, and it is felt that the industries as a whole believe that they are disposing of their wastes at an economical figure and in a most satisfactory manner and are well pleased with the service and method of charging.

The Village of Orrville is to be congratulated in having municipal officials who keenly appreciate the necessity of proper operation of their utilities. The Village Council as well as the Board of Public Affairs, under whose direction the maintenance of the sewage plant falls, is always willing to listen to constructive criticism. The sympathetic support of the management has been invaluable, and likewise the plant operating personnel's loyalty to their duty has made, what otherwise might have been, an unpleasant task a pleasant one.

Acknowledgment: The above paper was read before the Ohio Conference on Sewage Treatment, Oct. 2, 1936, at Columbus, Ohio. It is reproduced by special permission of the author and the Executive Board of the Conference.

▼

Harry Hendon Sails to Address British Institute

Harry H. Hendon, Birmingham's (Ala.) Sanitary Engineer, sailed on the Bremen February 2nd for Europe. His trip has been occasioned by an invitation to address the British Institute of Chemical Engineering on the topics of American Practices in Sewage Treatment by Chemical Processes. Mr. Hendon, as Jefferson County Sanitary Engineer, in charge of the Birmingham, Ala., sewerage system, attracted wide interest in chemical treatment through his flexible and attractive design of the successful Shades Valley Chemical Treatment Plant of Birmingham and the attendant design of two additional plants. After his visit to England, he will spend a fortnight traveling on the Continent.

The night of his sailing was the occasion of a bon voyage dinner in his honor, given by Linden Stewart, President and "Skipper" of Wailes Dove-Hermiston Corp., at the Union League Club in New York City.

▼

Meetings Scheduled:

Feb. 15-20—College Station, Texas (State College).
Texas Water Works Short School. Sec'y, V. M. Ehlers, Chief Engr., State Dept. Health, Austin, Texas.

Feb. 18—Boston, Mass. (Hotel Statler).
New England Water Works Association. Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.
(Also meeting March 18th.)

Mar. 11-12—Trenton, N. J. (Stacy-Trent Hotel).
New Jersey Sewage Works Association. Sec'y, John R. Downes, Bound Brook, N. J. (22nd Annual Meeting.)

Mar. 25-26—Indianapolis, Ind. (Antlers Hotel).
Indiana Section, A.W.W.A. Sec'y-Treas., J. A. Bruhn, Box 855, Indianapolis, Ind.

Mar. 30-Apr. 1—Ocala, Florida (Camp Roosevelt).
Florida Section, A.W.W.A. Sec'y, J. R. Hoy, W. & T. Co., 404 Hildebrant Bldg., Jacksonville, Fla.

Apr. 5-7—Chattanooga, Tenn. (Hotel Pattern).
(a) **Southeastern Section, A.W.W.A.**
(b) **Kentucky-Tennessee Section, A.W.W.A.**
—Joint Meeting.
(a) Sec'y-Treas., W. H. Weir, Ga. State Dept. Health, Atlanta, Ga.
(b) Sec'y, H. D. Schmidt, Tenn. State Dept. Health, Nashville, Tenn.
(This notice supercedes previous notices of separate meetings.)

Apr. 14-16—Montreal, Canada (Windsor Hotel).
Canadian Section, A.W.W.A. Sec'y-Treas., A. E. Berry, Chief Engr., Ontario Dept. of Health, Parliament Buildings, Toronto, Ont.

Apr. 19-22—Lewistown, Mont. (Hotel Burke).
Montana Section, A.W.W.A. Sec'y, H. B. Foote, Chief Engr., State Board of Health, Helena, Mont.

Apr. 22-23—Philadelphia, Pa. (Hotel not selected).
(a) **Four States, A.W.W.A.**
(b) **Penna. Water Works Operators' Assn.**
—Joint Meeting.
(a) Sec'y-Treas., Carl A. Hechmer, Washington Suburban San. Distr., Hyattsville, Md.
(b) I. M. Glace, Harrisburg, Pa.

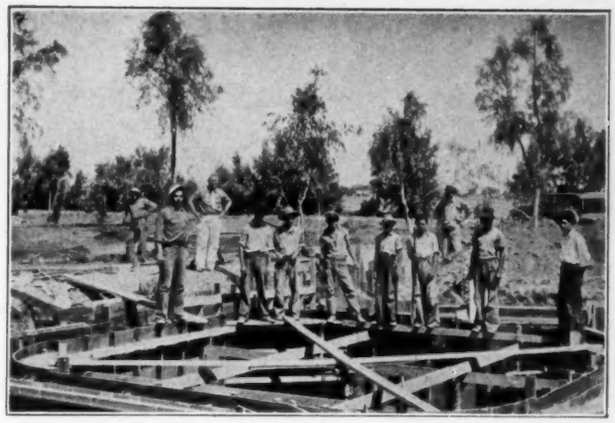
Apr. 29-30—Springfield, Ill. (Abraham Lincoln Hotel).
Illinois Section, A.W.W.A. Sec'y, W. D. Gerber, Engr., State Water Survey Div., P. O. Box 232, Urbana, Ill.

May 6-7—Wilmington, Del. (Hotel Dupont).
Maryland-Delaware Water & Sewerage Assn. (11th Annual Meeting.) Sec'y-Treas., A. W. Blohm, 2411 N. Charles St., Baltimore, Md.

May 20-22—Victoria, B. C. (Empress Hotel).
Pacific Northwest Section, A.W.W.A. Sec'y, Fred Merryfield, Prof. of C. E., Oregon State College, Corvallis, Ore.

June 4-5—Utica, N. Y. (Hotel not named).
N. Y. State Sewage Works Assn. Sec'y-Treas., A. S. Bedell, State Dept. Health, Albany, N. Y.
(Manufacturer's exhibits a feature of this meeting.)

June 7-11—Buffalo, N. Y. (Hotel Statler).
American Water Works Association (Annual Convention). Executive Secretary, Harry E. Jordan, 29 West 39th St., New York City.



The N.Y.A. "Gang" on the Job—Both at Work and Play. They Were Building Something That They Took an Interest in Seeing Come Into Being. The Construction Is Now Complete and Most Fun Will Come When the Boys Assemble the Parts of the Detritor Mechanism and Put It to Work.

PHOENIX SEWAGE PLANT GETS MUCH NEEDED DETRITOR

Financed by the City, Construced With N. Y. A. Help at a Net Saving of Almost $5,000

By DARIA TRAVAINI
Supt. of Treatment Works, Phoenix, Arizona

THE City Commission of Phoenix, Arizona, appropriated $8,600 in the 1935-36 Sewage Treatment Plant budget to construct a detritor to eliminate grit from the sewage flow. The grit had been magnifying difficulties in plant operation. It caused excessive wear of the machinery and stoppage in sludge lines and loadings, on the digester mechanism.

The design called for a twenty-foot Dorr Detritor, the engineering estimate for its construction being $7,500. It was estimated that a constructor with proper equipment and trained personnel could complete the work within a month or less. When the bids were called, however, the lowest bid received was $12,400. The city had not budgeted this amount of money, so it was necessary to build the detritor by force account, if such a unit was to be added to the plant. The installation of this unit was made possible with labor supplied, in the form of young men, through the National Youths' Administration—N.Y.A. The actual construction cost totaled only $7,493.78, leaving the City of Phoenix $4,906.29, when considering the competitive contractor's bid as a fair one.

D. Travaini
Plant Superintendent

Jane H. Rider
State Director, N.Y.A.

Prior to the construction of the detritor, another N.Y.A. project had been approved for the Phoenix Sewage Treatment Plant, the youths being employed on landscaping, gardening, and grounds improvement. The writer believed that if the youths could be used in the construction of the detritor, two objectives would be obtained. The youths would obtain discipline and construction experience under strict supervision; equally important, to him at least, the city could build the badly needed detritor.

Permission to use the N.Y.A. man power for construction was granted, and work was begun on March 24, 1936, and completed on May 22, 1936. The N.Y.A. youths are allowed 23 hours per period, which amounts to 46 hours per month. We double up our crews in order to have sufficient man power during construction. This meant that work was actually in progress only five weeks out of the eight weeks required from the beginning to completion of the work. The job remained idle during the intervals when the youths had completed their quota of work. This was not detrimental to the city because the carpenter and the operators, which were being used to help supervise the youths, had a great deal of maintenance work to be done on plant equipment.

The work required more supervision than is ordinarily afforded, since to many of the young men on the project, this work was their first construction experience. Also we were delayed at the beginning as the young men were soft and, therefore, tired easily. In spite of these handicaps the interest taken by the youths and their willingness to do hard work under the blazing Arizona desert sun resulted in favorable costs. For instance, we excavated and loaded by hand a total of 243 yards of dirt, hauled the excavated material a quarter of a mile, and spread it on a low area on the plant ground at a cost of $1.39 a yard.

Phoenix Treatment Works—Had Everything But a Detritor.

A total of 66.4 yards of concrete was poured at a cost of $29.76 per yard. This cost includes lumber, the building, placing and bracing of complicated forms, the cost of reinforcing steel and its cutting, bending and placing, the cost of the concrete aggregate, cement, mixing and placing the concrete, the stripping and salvaging of form lumber, and the hand finishing of the concrete. Considering the intricate form work, the inexperience of the crew and the small size of the job, this cost is not excessive.

The city is more than pleased with the work performed by the youths on this N.Y.A. project, and we hope to build other improvements with their aid during the year. The young men went to their work with a vim and vigor and took a genuine interest in seeing the job grow to a worthwhile structure from a hole in the ground and loose material.

Cost records, carefully kept, follow and we do not need to explain anything. We are getting a decidedly needed appurtenance for much less than anticipated. More important, we got it this year—and not next.

For her interest and assistance, we are greatly indebted to Miss Jane H. Rider, State Director of N.Y.A.

TOTAL COST—20-FOOT DORR DETRITOR

Materials and mechanical equipment	*$6,011.74
LABOR	
Engineering, supervision and plant operators' time	570.90
Carpenter	214.00
N.Y.A. Youths	533.34
Equipment rental	163.80
TOTAL	$7,493.78

*Note: We estimate an additional $140.00 for erecting and wiring the Dorr Mechanism on its arrival. This figure may be high, however. The mechanism cost $4,222.00 delivered, but not installed.

▼

John H. Gregory Dies Suddenly

John H. Gregory, consulting sanitary engineer of Baltimore, Md., and professor of sanitary engineering at Johns Hopkins University, died suddenly in his home on January 18th. He was 62 years of age, and had built for himself a high reputation as consultant in the water supply and sewerage field.

Professor Gregory, an 1895 graduate from the Mass. Institute of Technology, became associated with the late Alan Hazen early in his career. Thereafter he became a partner of the late Rudolf Herring in consulting practice. In 1917 he entered the Sanitary Corps of the U. S. Army as a captain and in 1920 went to Johns Hopkins University as professor of civil and sanitary engineering and, with it, kept up a consulting practice. At the time of his death he was serving as advisor to Columbus, O., in the design and construction of its new sewage treatment works. He was a member of the Board of Direction of the American Society of Civil Engineers, which had twice honored him with awards (the Rowland Prize —1910; and the James Laurie Prize—1930) for outstanding papers delivered before it.

Handbook of Chemistry and Physics (1937 Edition)

Chemical Rubber Company's 1937 Edition of their widely known "Handbook of Chemistry and Physics" has been issued. In its 23rd year, the 1937 edition contains 175 pages of new composition amongst its total of 2,023 pages of data and tables, covering basic information required by engineers and chemists. Chemistry, Physics, Mathematics—all three major fields are covered in this handy sized flexible covered volume.

The new edition is divided into five logical sections for quick and easy reference. Revised or enlarged has been the important Numerical Tables; Laboratory Receipts; Photographic Section; Factors for Calculating or Conversion of Gas Volumes, and other sections. The following appear:

	Pages
Mathematical tables and formulae	302
Chemical tables	741
Physical properties and constants	197
Heat and thermodynamics	154
Electricity and magnetism	108
Light, reflection, transmission	141
Barometric and hygrometric tables	20
Sound—its properties	7
Antidotes and accident handling	4
Miscellaneous tables	353

Subject to a ten-day examination, the price of the handbook is $6.00. Publishers, The Chemical Rubber Co., 1900 West 112th St., Cleveland, Ohio.

▼

New A.S.T.M. Book of Standards

The 1936 edition of the American Society of Testing Materials. 1,390 page, "Book of A.S.T.M. Tentative Standards" is out. It contains 264 tentative specifications and methods of test, and definitions of terms covering widely used engineering materials. A large number of *new* standards, approved during 1936, appear in this publication for the first time.

During 1936 important amplications and changes were made in a number of existing specifications and all of these, in the latest approved form, are given in the new edition. In addition to the *tentative* standards there are included also all of the *proposed revisions* of formal A.S.T.M. standards, these revisions being published to elicit criticism before final adoption.

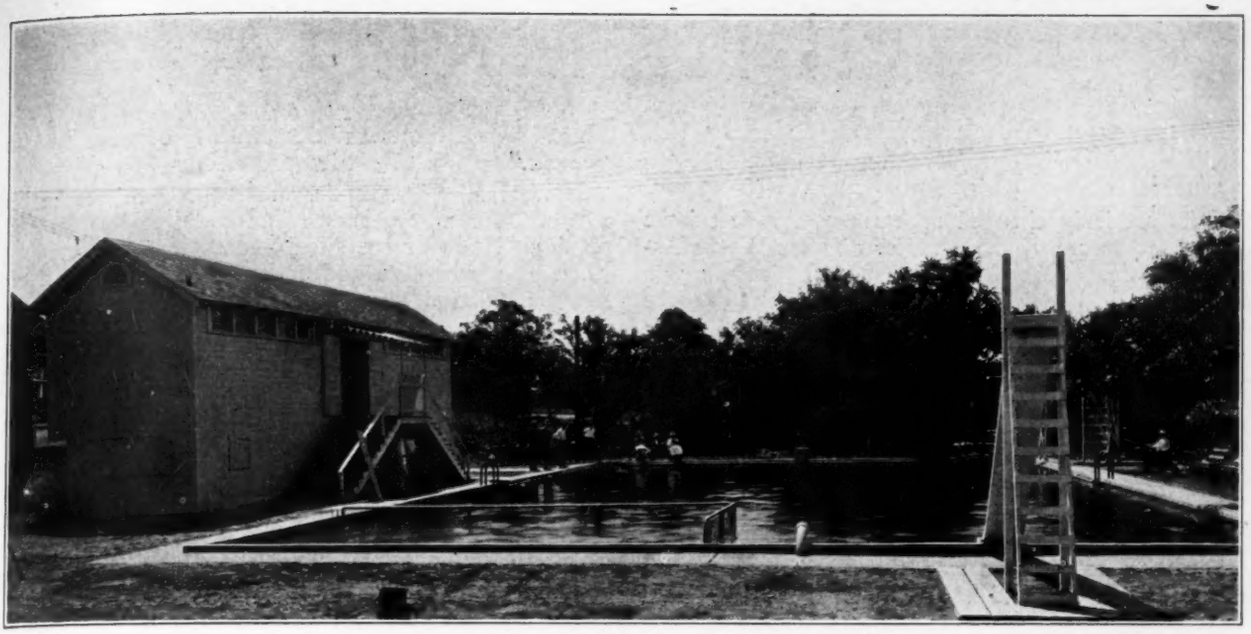
Copies in cloth binding are $8.00. (Heavy paper cover, $7.00.) Can be ordered from A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, Pa.

▼

Texas Assn. to Produce Water Works Operators' Manual

Elsewhere in this issue is announced the forthcoming Annual Texas Water Works School, to be held February 15th-20th at A. & M. College, College Station, Texas. This constitutes the "1937 Edition" of America's oldest Operators' Short School—envisioned by and established by a pioneering sanitary engineer—Victor M. Ehlers, then and now, Chief Engineer, Texas State Department of Health.

The program for the 1937 school is devoted largely to presentation of material by authorities selected to write chapters or articles for the forthcoming Water Works Operators' Manual, which is being produced as a project of the Texas Water Works Association. Together, with the State Department of Health and A. & M. College of Texas, this association is a joint sponsor of the Texas Water Works School. The new manual is to be printed and distributed as soon after the school as possible.



"The Sprinkling Filter That Would a Swimming Pool Be." Behind the Bath-House Can Be Seen the Odorless Sewage Pumping Station, nee the Old Imhoff Tank

A SPRINKLING FILTER THAT WOULD A SWIMMING POOL BE

By LEVI GOODRICH
City Engineer, Marlin, Texas

Marlin's Sewage Treatment Plant suffered a case of "S-O" that even Chlorine could not economically cope with—and, that is saying a lot. Result: a new treatment plant, a Municipal Park, and a Swimming Pool. "Its an ill wind, etc."—says opportunist Goodrich.

THE complete salvage of an abandoned sewage treatment plant is unusual to say the least, but such a thing did occur in this city. Of some interest, perhaps, is the way it happened.

*Goodrich and Friend**

In 1928 it became necessary to relocate our sewage treatment plant because of an injunction secured by property owners living near the plant, which was located within the city limits.

After thorough consideration, it was decided to build the new treatment plant near the Brazos River and about four and one-half miles Southwest of the old plant.

This work was done in 1928 and the old settling tank was converted into a pump well, a new lift station being constructed adjacent. The crushed stone in the sprinkling-filter was later used in the construction of drives in the new Municipal Park, which consists of the old plant site and added ground to make an area of forty-five acres.

In 1933 it was decided to convert the concrete walled filter basin into a swimming-pool, which is shown in the accompanying pictures. The total cost of the job, including the bath-house, was approximately $3,000 exclusive of unskilled labor, which was furnished by the local

Before the Swimming Pool Was Built

Relief Administrator. Teams required and gravel for concrete purposes were furnished by the City.

The local American Legion Post assumed the $3,000 cost and by an arrangement with the City Council was granted the operating privilege. By charging a small admission fee to the new pool, the construction cost was paid off. Where there was once an obsolete and noisome sewage treatment plant, Marlin now has a useful park and, with it, an attractive swimming pool.

*Friend Ed. Whebee, now Sanitary Engineer of the Dallas Water and Sewerage Department; then Vic. Ehler's star State Board of Health Engineer, who with Ye Ed! literally poured Chlorine on the troubled waters. A pity had it cured this case of "S-O" (Sewage Odor) and killed a park and pool.—Editor.

EDITORIAL

Journals—Yellow and Blue

The Yellow:

BY its suddenly changed appearance, the first issue of the Journal of the American Water Works Association for 1937 proved little short of startling to many. That it did, was well; for an awakening to the value of the Journal is timely. Issue No. 1 of Vol. 29 of A.W.W. A.'s official publication now appears in a new dress of attention demanding yellow color as contrasted with the commonplace somber grey cover of previous issues. The new cover denotes the first issue of the Journal to be produced under the new arrangement, wherein the Journal is managed and edited wholly within the headquarters offices of A.W.W.A.

This change in Journal publishing came about coindentally with, rather than as a direct result of, the reorganization through which A.W.W.A. is passing. Abel Wolman, for sixteen years capable and proficient editor of the Journal, some months ago found his many other duties in a broadened field necessitated his retirement as A.W.W.A.'s editor. Persuaded by the General Policy Committee of A.W.W.A. to continue until reorganization of the association was sufficiently under way, Mr. Wolman was relieved on January 1st. For his valued services to the association, as its editor and in other directions, he has been fittingly voted the John M. Diven Memorial Medal, as recounted elsewhere in this issue. An appropriate acknowledgment of Mr. Wolman's services appears as a foreword in the January issue of the Journal under caption "An Appreciation." It states, that "In nowise has his fundamental loyalty to the water works field and to his Association lessened." "The years have been busy for him and he has grown greatly in distinction amongst men of standing in national affairs." These are the words of an appreciative successor to the task of managing the Journal, Harry E. Jordan, who recently took over the guidance of Association affairs as its Executive Secretary.

The new Journal (dare we say the "Yellow Journal") issues without benefit of "Editor." But, an examination of the January issue reveals that a master hand in respect to editorial ability has been responsible for the production. Some of the noteworthy innovations include the ready reference listing of "Contents" on the front cover; book reviews, which have been handcarved by Mr. Jordan; the grouping of articles with respect to related interests and similarity of topics. Such, for instance, is the grouping of four brief superintendents' articles dealing with "Distribution System Maintenance," and so listed under "Contents" on the front cover.

Then comes to notice a change of much meaning to those who make possible the financing of the Journal—its advertisers. What was at one time (suspended during the depression) issued as a "Supplement" to the Journal now becomes an "Implement." It bears the caption, *"News of the Field."* This new and newsy section of the Journal starts at the beginning of the advertisers' section and runs as a continuing story which threads its course through the pages of advertising. Most assuredly the ordinary "thumbing through" practice of readers (if that) is not likely to be as valuable to the Journal's bread and butter providers as the reading through process of the advertising section is designed to effect. Thus, the news "supplement" becomes an "implement."

If the reader be skeptic, and suspects this to be just a "puff" for a rejuvenated Journal, just let him start reading "News of the Field"—and, then, try stopping when he reaches the notification—(*Continued*). Note, too, the "thread" leads the reader to no stated page number; and this feature requires that the next half page, and the next, be looked for by "feeling" his way through the "hall of manufacturers' exhibits." Does this imply that the Journal is to be run for, or by, its advertisers? Not at all; but, there seems ample justification for a publishing plan wherein the supporting advertisers get the permissible maximum in the way of value received. This, in order that A.W.W.A.'s Journal may grow in value.

Why the yellow color of the Journal cover? The answer is found in the closing paragraph of "News of the Field" (Harry Jordan knew it would be seen there), which says of this new section:

> "No creaking plan will guide, no system will govern. If it be news and interesting to water works men, and we happen to learn of it, you will find it here." . . .
>
> "You have grown to think of this JOURNAL as a thoroughly dignified and well edited publication. It is hoped to add a bit of affability to its other good qualities. Hence, the yellow cover (a 'good' fire-hydrant color) put on the magazine for the same purpose that yellow is put on hydrants—high visibility. We hope it may also remind men in the field that the JOURNAL is just as essential to an efficient water works man as a 'good' hydrant is to an efficient water works system."

That constitutes the (*Finis*) of "News of the Field" for January; the beginning of a new era for A.W.W.A.'s JOURNAL.

The Blue:

Another official association publication, now in its ninth year, has gained materially in quality and circulation during the past year. Although its color may be blue, its future seems rosy. We refer to Sewage Works Journal, the official publication of the Federation of Sewage Works Association of America.

To the Board of Control of the Federation, W. W. Buffum, who has served as the unpaid but valued Business Manager of this publication since its inception, recently reported better than a twenty per cent gain in circulation during 1936. This signifies the growth in organizations of sewage works men in America, through which distribution of Sewage Works Journal is made. This publication, starting from scratch, was long underwritten by The Chemical Foundation, Inc., but in 1936 became a self-supporting journal by a slight margin. Going now on its own, the prospects for its continued advances in distribution and financial soundness are bright. That its cost to the association members is but $1.50 per year for (six issues) represents an astounding value, indicative of careful editorial and business management. And, likewise, the part which advertising income plays in the production of such a journal. With increasing distribution, an influx of new support from advertisers, and broadened editorial make-up, Sewage Works Journal's future—like that of A.W.W.A.'s Journal—is brighter than ever before.

No longer is it "a call of duty" for advertisers to support these two official association publications; it is now a clean cut service from which value received is the end to be expected.

One of two 5-foot revolving fine disc screens designed and built by Krajewski-Pesant Mfg. Co., New York, for the United States of Venezuela for purification of sewage at Leper Colony at Cabo Blanco, Venezuela. The entire slotted discs are made from 3/16" EVERDUR Metal slotted with 1/32" wide x 2 1/2" long slots which are relieved on the effluent side to permit a high orifice coefficient. The solids entrained in the sewage are retained on the surface of the disc and during each revolution are brushed into receiving hoppers for final incineration. . . . The cone also is made of EVERDUR, together with all the fastening screws and bolts.

ANACONDA
from mine to consumer

NON-RUST

Everdur* Metal used in revolving screen for Venezuela

Uniformly excellent resistance to corrosion in contact with various liquids makes EVERDUR preferred for sewage plants

Engineers who have studied the performance of EVERDUR Metal in sewage treatment attest its value for many uses...including slide gates, weir plates, supporting bolts, baffle plates, screens and other metal parts exposed to corrosion.

EVERDUR for this purpose is a copper alloy which combines the strength of steel with unusually high resistance to corrosion. It is readily fabricated by all methods — including welding. Since 1927 Everdur Metal has been chosen for many sewage applications. Data on typical installations mailed on request.

*EVERDUR METAL—EVERDUR is a registered trademark identifying alloys made exclusively by The American Brass Company. S7387

Anaconda Copper & Brass

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities . . . In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

EQUIPMENT NEWS

"Permaseal" Pipe Jointing Compound

Berry Asphalt Company of Chicago is offering an improved asphalt-base sewer pipe jointing-compound introduced under the name "Permaseal." A patented Berry product, this compound was developed to meet sewer pipe joint specifications calling for: resiliency with tightness (adhesiveness; root repellent qualities; ability to pour into wet joints. The new product when molten does not lose its uniform texture; has no inert (weight adding mineral filler to segregate and cause trouble in the melting pot; therefore, in melting requires no watching or stirring.) Poured into a wet joint, where there may be as much as 2 inches of water, it will not foam. Due to the elimination of heavy mineral filler, the weight of "Permaseal" per joint is lower than most other compounds—(6 in. = 0.6 lbs.; 12 in. = 1.21 lbs.; 24 in. = 5.14 lbs.). Specific gravity is but 1.00 to 1.03; average weight per cu. ft. = 63.5 lbs. "Permaseal comes packed in 425 and 200 lb. light steel drums—also in a repair size bucket (45 lbs.) which serves as its own melting pot. For additional information and a copy of "Facts on Sewer-Pipe Jointing," and a new "Handbook on Sewer Pipe Jointing" address Berry Asphalt Co., 1472 West 76th St., Chicago, Ill.

▼

Record Leak Detection

S. F. Ferguson, President, Water Leak Detector Company, Columbus, Ohio, advises that a new record has been established in long-distance water leak detection. The St. Louis Water Department now holds the laurels, having beaten the 1936 Columbus record. Mr. Ferguson's record involved the location of an important leak (110,000 gls./day) 650 feet distant from his novel radio frequency instrument.

The new record, made during December, by the St. Louis Water Department was also made with a Universal Leak Detector attached to a fire-hydrant. The point of reconnaissance was actually 1,050 feet from the leak, later found to be 250,000 gals./day. It was all accomplished (as we understand it) through detection of a tuned in vibration frequency caused by "leak-waves," set up on the main, as the result of leaking water-hiss. By manipulation the direction and magnitude of the waves (leak) was determined . Once on the trail the "leak - hounds" rapidly closed in.

▼

Proportioneers Offering Emergency Service

In a special "flash message," Proportioneers, Inc., of Providence, R. I., have notified state and local health authorities, and others in charge of water supply during and following catastrophes, that PROPORTIONEERS stand ready to answer emergency calls for chlorinating equipment and special service. In making this offer, the fact that no obligation is incurred on the part of any community or organization thus assisted, is emphasized. This flash went out early in the recent flood peril which proved so devastating to Ohio Valley communities.

Every catastrophe brings more forcibly to the public mind the high importance of an amply safeguarded water supply, and it is in such times that emergency services of water works equipment manufacturers are most valuable and so deservedly appreciated by all concerned.

▼

Boncher Made Dresser's Sales Manager

Friends of H. P. Boncher in the water works and sewerage fields will be pleased to learn of the fact that on January 1st he was made General Sales Manager of the S. R. Dresser Manufacturing Company of Bradford, Pa. Mr. Boncher started up the ladder with the Dresser Company, through the successful popularization of flexible Dresser Pipe Couplings and repair devices, in the gas and oil fields. He saw a similar opportunity in the water works field and the rapid spread of popularity of Dresser Couplings in the latter bespeaks his and the company's success in this direction.

H. P. Boncher

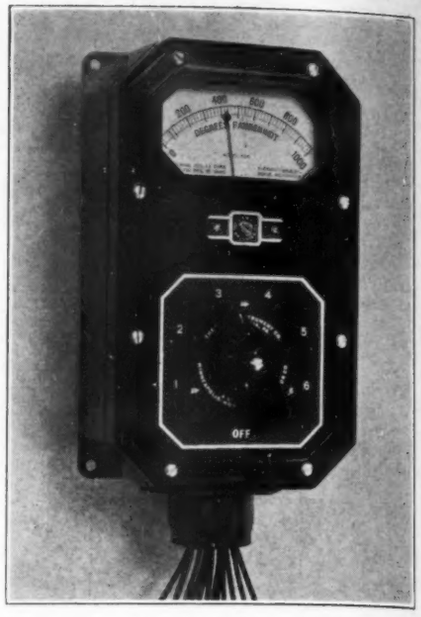
Other promotions in Dresser officialdom include, M. N. Davis to Executive Vice-President and Secretary; R. E. Reimer to Assistant General Manager and Treasurer; H. N. Mallon, continuing, as President and General Manager.

▼

New Diesel Engine Pyrometer

A new pyrometer, designed especially for Diesel Engine service, has just been announced by the Brown Instrument Company, Philadelphia—a division of Minneapolis-Honeywell Regulator Company.

The new pyrometer has been designed for ruggedness, with vibration resistance built into it. It is sensitive, but capable of close accuracy under the most severe Diesel service. The case is of light weight Bakelite and waterproof in construction. It has the dial type switch with extra large points, integral with the pyrometer, but in its separate compartment below—see cut. The temperature scale is made of enameled metal for permanency.



Brown Diesel Engine Pyrometer

The new pyrometer is available with 4, 6, 8, 12, 16 or 24 switch points and for three temperature ranges (zero to 1000; 1200 or 1600 deg. F.) with "cold," "normal" and danger operating zones plainly identified on the scale. Each instrument is calibrated for accuracy when employing Brown I.C. Thermocouples.

For a complete and illustrated description, write for "Brown Pyrometer Catalog No. 1001." Address Brown Instrument Co., Wayne & Roberts Aves, Philadelphia, Pa.

▼

Lawrence C. Hough Dies

Lawrence C. Hough, 45 year old District Engineer-Manager for the Pitometer Company of New York City. While on a business trip in Savannah, Ga., he suffered a heart attack on January 13th and died the same day. Born in Falls Church, Virginia, he studied at Cornell University from which he was graduated in 1914 as a Civil Engineer. His first position was with the late Jas. A. Fuertes, Consulting Engineer. Thereafter he held a position with the Public Service Commission of New York City. For the past 20 years Mr. Hough had been connected with the Pitometer Company, except for that period during which he served as officer of artillery in the World War forces. In 1924 he was made District Manager in charge of all New England States, New York, Georgia and Florida.

For his company "Larry" Hough had made a number of important waste and leakage surveys in large cities. And, through his pleasing and unassuming personality, made many friends for himself and his company. He is survived by his widow who, fortunately, was with him in Savannah at the time of his untimely death.

REGARDLESS of the pipe material, Dresser Couplings reduce the pipe cost by eliminating special preparation of the ends; simply specify PLAIN-END PIPE FOR DRESSER COUPLINGS. In making a Dresser joint, the plain ends of the pipe are easily shoved up to the center stop in the middle ring, after which the gaskets are tightly compressed against the pipe and coupling by pulling up on the bolts. The only tool necessary—a ratchet wrench for the bolts. A coupling for plain-end pipe permits using random lengths cut in the field and oftentimes salvaging what would otherwise be wasted. Dresser Couplings permit bends and provide flexibility without in any way changing either the plain-end pipe or the coupling.

S. R. DRESSER MANUFACTURING COMPANY
Bradford, Pa.

With DRESSER COUPLINGS

You've let 'S-O' put us in the RED

SEWER ODORS can put *any* unsuspecting community in the red. They're due to hydrogen sulphide gas, generated in the sewer lines and plant by sewage bacteria. The trouble is, hydrogen sulphide forms sulphuric acid, which attacks the lime in brick mortar and concrete. And there go the sewer walls . . . the sewer bonds . . . the balanced budget—and the city officials are on the spot, all because of "S-O." More than one California community has faced this situation, with a sewer to be replaced *years before the bonds have even been retired!*

Yet it's simple and inexpensive to prevent odor nuisance and protect your sewer investment, by treating the sewage with Bear Brand Chlorine. Chlorine neutralizes hydrogen sulphide gas and prevents its formation by killing the bacteria which generate it. Chlorination may also reduce operating costs by speeding up treatment, thus increasing efficiency and plant capacity. Initial cost and upkeep of chlorinating equipment are low. More than a score of California communities are using Bear Brand Chlorine for odor control and protection of sewers. We will be glad to answer inquiries regarding chlorination, or to have one of our sanitary engineers call, without obligation.

Liquid Chlorine . Ammonia . Ferric Chloride

GREAT WESTERN ELECTRO-CHEMICAL CO.

9 MAIN STREET, SAN FRANCISCO
PLANT: PITTSBURG, CALIFORNIA
4151 BANDINI BLVD., LOS ANGELES

CATALOGS AND LITERATURE RECEIVED:

[*Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.*]

"Special Flood Issue—Taste and Odor Control"—Not delaying their message for their regular monthly issue, Industrial Chemical Sales Co. (activated carbon producers) have rushed out a "Special Flood Issue" of their informative little publication—"Taste and Odor Control." It contains suggestions by John P. Harris, as to what to do *now;* and what to do *next,* in operating seriously overloaded if not disastrously crippled purification plants, due to flood waters. Stressing the necessity of getting more water (but safe water) through a plant, to meet heavy post-flood demands for the flushing clean up of streets and public buildings and private properties after the flood, he makes some timely suggestions. The first essential is that of securing the maximum degree of purification *ahead* of the super-loaded filters which, even at best, constitute the "bottle-neck" of a plant. These suggestions are aimed at procuring the critical and determining effect—namely, coagulation and clarification of the highest efficiency. To this end, he cites the especial value of superchlorination in conjunction with powdered activated "Nuchar" in procuring *maximum output with assured safety.* And, with it, minimum residuals of the suspicion breeding turbidity or taste and odor in the finished product. The "Special Issue of T. & O. Control" also contains an interesting group of flood pictures. For a copy, or for regular mailings of this publication, address Industrial Chemical Sales Co., 230 Park Ave., New York City.

"Carter Sludge Pumps"—From Ralph B. Carter Company, Hackensack, N. J., pump builders for 35 years and producer of the well known "Humdinger" pump, comes an 11 page illustrated bulletin telling *"Why Engineers Specify Carter Sludge Pumps."* Some of the reasons—Carter's had the first ball valves; the first renewable valve seats; the first herringbone gear reducer with ball bearing supports; the first quickly accessible valve chamber. In nine basic sizes (8½ to 12 inch cylinder diameters) the simplex, duplex and triplex types provide wide adaptability, in constant or variable capacities for the service required. Detailed specifications comprehend other desirable and practical features, likewise illustrated. Amongst these, are the wrap-around chain drives; all-fanged connections throughout; oversized air chambers; ball-bearing and self-aligning shaft supports; drip and moisture proof motors; highly flexible vari-speed drive; automatic plunger lubrication. Typical installations are listed and picture. Also are illustrated Carter's Portable Utility Pumps. For a copy of a worthy bulletin—"Carter Sludge Pumps"—address, Ralph B. Carter Co., Hackensack, N. J.

"Barrett Protective Coatings for Water Works":—Fresh from the print shop has come a new and impressive (illustrated) brochure from the Barrett Company. Featured therein is the set of complete "Specifications for Bituminous Primers and Enamels," for lining and coating water pipes. Detailed are those specifications covering composition and test requirements for primers and coal-tar base enamels—likewise, procedures (including A.S.T.M. Methods) for making analyses and tests. Then follows a section setting forth methods of

preparing the pipe and "The Application of Barrett Special Water Works Primer and Enamel" to pipe, fittings, specials, and field joints. At the end are valuable suggestions pertaining to the handling of coated pipes, and procedure in touch-up work. In a foreword, Barrett offers 83 years of experience in producing coal-tar base coatings—the perfection of which, for water works applications, covers a 10 year period. Offered, also, is the cooperation and service of its recently enlarged Pipe Line Service Department. For a copy of "Specifications for Protective Coatings for Water Works"—address, The Barrett Company (Dep't W. & S.), 40 Rector Street, New York City.

"Designed Economy for Water Systems"—Here is a new and handsomely gotten together spiral-bound and colorful bulletin of 48 pages. It is a production of American Rolling Mill Company of Middletown, Ohio. Its essential purpose is that of discussing and evaluating reasons why steel pipe deserves every consideration in "Economy Designing," as applied to water supply systems. Specifically, it sets forth the merits of spiral-weld pipes of Armco Ingot Iron in a very interesting and readable style. It describes and pictures the methods of production, testing and application of protective coatings, which is followed by pertinent "Technical Data." Methods of handling, laying and jointing, with Dresser type couplings, flanges, welding, are treated in some detail. Corrosion and protective coatings are but lightly treated, whereas, "Hydraulics of Pipe" and interior corrosion effects are covered rather effectively in a readily understood presentation, illustrated by a group of "Examples of Flow Determination." For a copy of "Designed Economy" (Armco Bulletin No. 136) address, American Rolling Mill Company, Pipe Division, Middletown, Ohio.

"Worthington's Sludge-Gas Engines"—Is a new Worthington bulletin covering a time tested product—namely, Worthington Gas Engines. It describes and pictures the vertical four cycle Worthington (15 to 1800 H.P. units), especially adaptable to use of gas from sewage sludge digestion. From the sewage of each 100,000 persons the bulletin figures conservatively that 150 H.P. value of sludge gas can be dependably predicted. Of the 24 listed recent installations of Worthington engines, at treatment plants serving 17 municipalities, that at Coney Island, N. Y., represents the largest (3 units, 900 H.P.) whereas the smallest is that at Edwardsville, Ill. (1 unit, 15 H.P.). The bulletin is principally given over to interesting pictures and brief descriptions of installations at representative plants, from the smallest to America's largest, now operating. For "Sewage Sludge Gas Engines" address, Worthington Pump and Machinery Corp, Harrison, N. J.

"Multi Pipe Protection"—In a bulletin captioned "Two Sides to the Story of Pipe Protection," Hill-Hubbell & Co. (Dvision of General Paint Corp.) describe and illustrate their method of applying a tough protective coating to the outside, and a corrosion resistant double coating to the inside of steel pipes. For the exterior, two coats of "Biturine" bituminous enamel are protected by felt-wrapping further protected by strong kraft paper backing. Advocating a shop operation for protectively lining, coating and wrapping pipe in the most dependable and controlled manner, the bulletin lists six important steel pipe producers now employing the Hill-Hubbell Multiple Process of lining and coating. For this descriptive bulletin, address, Hill-Hubbell Corp., Chicago, Ill., or General Paint Corp, San Francisco, Calif.

"WE WOMEN DEMAND SOFT WATER!"

WANT WOMEN'S SUPPORT?

—here's a sure way to get it

● Housework is hard work. Hard water makes housework harder. But soft water makes housework *easier.*

Women will applaud any public project (or person) that promises them soft water. And they can get plenty of support.

Be on the popular side—the constructive side. Start active promotion of a municipal water softening system in your town. We'll help you all the way.

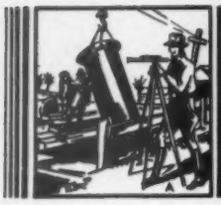
We will plan your plant, submit proposal and estimates, specify and install the equipment, organize, train and supervise the operating force, and furnish all needed service.

The public today expects local as well as Federal government to provide improvements that definitely add to the comfort and convenience of the people. A modern municipal water softening plant is an ideal project of this type.

Write us now for further information. Address THE PERMUTIT COMPANY, Dept. G1, 330 West 42nd Street, New York, N. Y.

Permutit

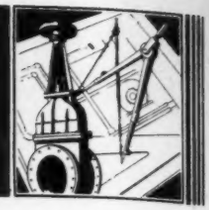
Water Conditioning Equipment



Consulting Engineers

Specializing in the field of

WATER WORKS & SEWERAGE



Albright & Friel, Inc.

Engineers

Chester E. Albright — Francis S. Friel

Water Supply and Purification
Sewerage and Sewage Disposal
Industrial Waste and Refuse Disposal
Investigations — Valuations — Reports

1520 Locust Street
Philadelphia, Penna.

John W. Alvord
Charles B. Burdick
Louis R. Howson
Donald H. Maxwell

Alvord, Burdick & Howson

Engineers

Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation

Civic Opera Building — Chicago

Barstow & LeFeber, Inc.

Municipal—CONSULTING ENGINEERS—Industrial

Water Supply and Purification, Sewerage, Sewage and Trade Waste Treatment, Valuations, Rates, Management, Chemical and Biological Laboratories.

E. D. Barstow — Alfred LeFeber
Associate Engineers
H. H. Mace — L. F. Converse — Wm. H. Carr

American Bldg., Cincinnati, Ohio — **Mendenhall Bldg., Akron, Ohio**

Black & Veatch

CONSULTING ENGINEERS

4706 Broadway, Kansas City, Mo.

Sewerage, Sewage Disposal, Water Supply, Water Purification, Electric Lighting, Power Plants, Valuations, Special Investigations, Reports and Laboratory Service

E. B. Black — N. T. Veatch, Jr.
A. P. Learned — H. F. Lutz
F. M. Veatch — E. H. Dunmire
E. L. Filby

Burns & McDonnell

Engineering Co.

McDONNELL-SMITH-BALDWIN-TIMANUS-McDONNELL

Consulting Engineers Since 1897

Waterworks, Light and Power, Sewerage, Reports, Designs, Appraisals, Rate Investigations

Kansas City, Mo., 107 West Linwood Blvd.
Cincinnati, Ohio, 307 East Fourth St.
Albany, N. Y., 11 North Pearl St.

Chester, Campbell, Davis & Bankson

The Chester Engineers

Water Supply and Purification, Sewerage and Sewage Treatment, Power Development and Applications

Investigations, Appraisals, Rates, Testimony, Design, Supervision, Operation, Accounting

130 Seventh Street, Pittsburgh, Pa.

Chicago Testing Lab., Inc.

and affiliated

Chicago Paving Laboratory, Inc.
Consulting and Inspecting Engineers

HUGH W. SKIDMORE — GENE ABSON

Materials, Processes, Structures, Consultation, Inspection, Testing, Design, Research, Investigation and Experts in Litigation.

536 Lake Shore Drive — Chicago

Fuller & McClintock

Engineers

F. G. Cunningham — C. A. Emerson, Jr.
Elmer G. Manahan — Ernest W. Whitlock
H. K. Gatley

Sewage Treatment, Sewers, Waterworks, Purification, Drainage, Waste Disposal, Valuations

11 PARK PLACE — NEW YORK

Gascoigne & Associates

Consulting Sanitary Engineers

G. B. Gascoigne — A. A Burger
W. L. Havens — F. W. Jones
C. A. Emerson, Jr. — F C. Tolles

Water, Sewage, Garbage and Industrial Waste Problems — Valuations and Rate Investigations

CLEVELAND, Leader Bldg. — **NEW YORK, Woolworth Bldg.**

Greeley & Hansen

Hydraulic and Sanitary Engineers

Investigations and Reports. Plans and Specifications. Supervision of Construction. Supervision of Operation. Water Supply and Purification, Sewerage and Sewage Disposal, Garbage Collection and Disposal, Appraisals

6 N. Michigan Avenue, Chicago, Ill.

Nicholas S. Hill Associates

Consulting Engineers

Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction, Operation, Management, Chemical and Biological Laboratories.

112 East 19th St.
New York

Morris Knowles, Inc.

Engineers

Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning.

Pittsburgh, Pa.

Metcalf & Eddy

Engineers

Water, Sewage, Drainage, Refuse and Industrial Wastes Problems, Laboratory, Valuations.

Statler Bldg., Boston

Nussbaumer & Clarke, Inc.

Newell L. Nussbaumer — Irving Clarke
Z. B. Phelps, Jr.

Water Supply & Purification
Sewerage & Sewage Disposal
Garbage Incineration

327 Franklin St., Buffalo, N. Y. — **69 Henry St., Binghamton, N. Y.**

Malcolm Pirnie

Engineers

Water Supply, Treatment, Sewerage Reports, Plans, Estimates.

Supervision and Operation.
Valuation and Rates.

25 W. 43rd St., New York, N. Y.

Potter, Alexander, C. E.

Hydraulic Engineer and Sanitary Expert

Sewerage and Sewage Disposal, Water Supply and Purification.

50 Church St., New York

Thomas M. Riddick

Consulting Chemist

Municipal and Industrial Water Purification, Sewage Treatment, Operating Supervision of Plants, Sanitary Surveys, Stream Pollution Investigation, Swimming Pool Control. Chemical and Bacteriological Analyses, Testing of Materials.

369 East 149th Street, New York City
(Tel.: Melrose 5-6579)

Whitman & Howard

Harry W. Clark

Associate Engineers (Est. 1869—Inc. 1924)

Channing Howard — Paul F. Howard
Walter A. Janvrin — C. Roger Pearson

Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.

89 Broad St., Boston, Mass.

ANTHRAFILT

. . . for more porous filter beds

●

Anthrafilt results in greater porosity in filter beds due to the vast difference in shape of the irregular particles and the fact that looser packing is possible.

In addition, Anthrafilt doubles the length of filter runs because it can be used in larger sizes than sand with less clogging from algae or other fibrous substances.

Samples, quotations and references without obligation.

●

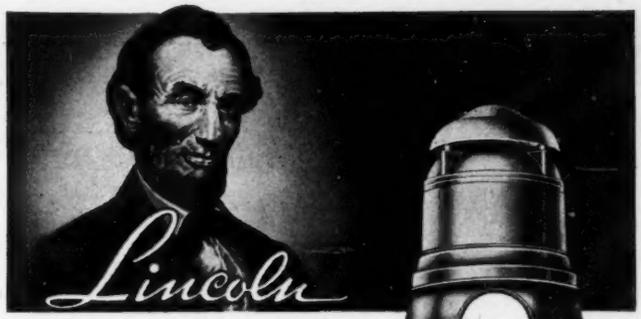
THE HUDSON COAL CO.

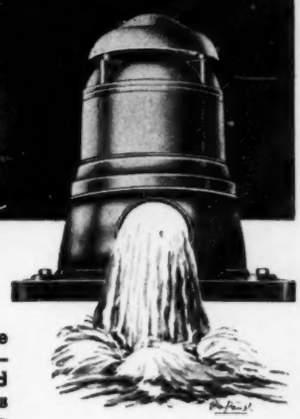
SCRANTON, PENNA.

G. B. Fillmore
General Sales Agent

LACKAWANNA "the Diff." ANTHRACITE

H. H. Shaver
Asst. Gen. Sales Agent





WAS RIGHT!

"SOME of the people can be fooled some of the time"—but few buyers can be fooled even the second time on pumps or well water systems. Layne Pumps and Layne Well Water Systems bear an envious reputation for quality and efficiency. The name Layne stands as the leader—the one to whom all refer as the standard of comparison.

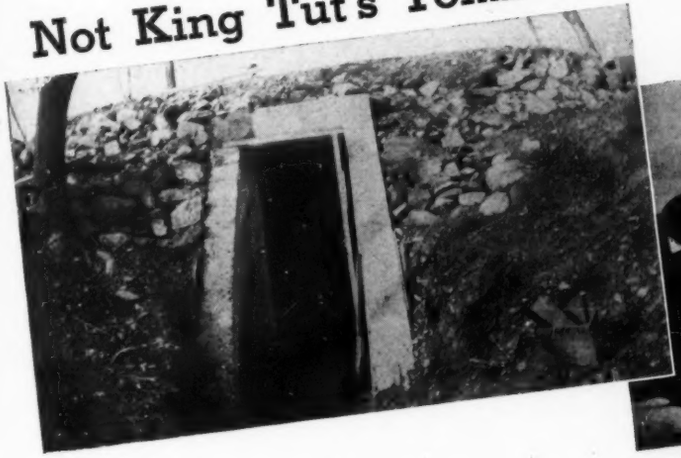
Municipal and Industrial executives who have plans for more water should call in one of our hydrological engineers. For illustrated literature, write Layne & Bowler, Inc., Dept. D, Memphis, Tenn.

AFFILIATED COMPANIES

LAYNE-ARKANSAS CO., STUTTGART, ARK.—LAYNE-ATLANTIC CO., NORFOLK, VA.—LAYNE-CENTRAL CO., MEMPHIS, TENN.—LAYNE-NORTHERN CO., INC., MISHAWAKA, IND.—LAYNE-LOUISIANA CO., INC., LAKE CHARLES, LA.—LAYNE-NEW YORK CO., INC., NEW YORK CITY—LAYNE-NORTHWEST CO., MILWAUKEE, WIS.—THE LAYNE-OHIO CO., COLUMBUS, OHIO—LAYNE-BOWLER NEW ENGLAND CO., BOSTON, MASS.—LAYNE-TEXAS CO., HOUSTON, TEX.—LAYNE-WESTERN CO., KANSAS CITY, MO., CHICAGO, ILL., AND MINNEAPOLIS, MINN.—INTERNATIONAL WATER SUPPLY LTD., PORT ERIE, N., ONTARIO, CANADA.

LAYNE PUMPS
LAYNE WELL WATER SYSTEMS

Not King Tut's Tomb --

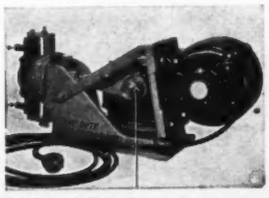


or Cliquot's Club --

just Chlor-O-Feeder's inexpensive winter quarters!

Injection to Water Line

Suction from Hypo Bottle



Residual Chlorine Adjust. Cam

As we have said before, Chlor-O-Feeder is not so subject to winter griefs—varying temperatures have practically no effect and you have nothing to fear from winter freeze-ups.

The view at the left is in South Glastonbury, Conn., and the view at the right in New Hartford, Conn.—typical of the unheated, inexpensively constructed, winter quarters in which many Chlor-O-Feeders are operating. This sturdiness is just the reason Chlor-O-Feeders are being chosen more and more to make small and medium sized water supplies safe by hypo-chlorination.

Bulletin "PH" illustrates the many types available, write—

%PROPORTIONEERS%, INCORPORATED, PROVIDENCE, R. I.

(Associated with Builders Iron Foundry, 9 N. Codding St., Providence, R. I.)

CONCENTRATE YOUR SOLUTION!

FEED FERRIC CHLORIDE IN A FORTY PER CENT SOLUTION THROUGH A PHIPPS & BIRD SOLUTION FEEDER

THE EXPOSED PARTS OF THIS SOLUTION FEEDER ARE NON-CORROSIVE. THERE ARE NO MOVING PARTS TO WEAR AND GIVE TROUBLE.

Write for Information

WE SPECIALIZE IN WATER WORKS EQUIPMENT

PHIPPS & BIRD, INC.

915 E. Cary Street **Richmond, Virginia**

Pressure : Sewer : Culvert : Subaqueous.

LOCK JOINT REINFORCED CONCRETE PIPE

LOCK JOINT PIPE CO. Est. 1905. Ampere, N. J.

GRUENDLER CRUSHERS

For Disposal of Sewerage, Sludge, Screenings and Garbage

Gruendler Shredders handle sludge and screenings so that 100% will pass bar screen.

Gruendler Garbage Shredders in any capacity for handling rubbish and garbage for incinerators or to be used as fuel in power plant and for disposal through sewerage system.

GRUENDLER CRUSHER & PULVERIZER CO.

Dept. S, 2915 N. Market St., St. Louis, Mo.

A New . . . HYDRATED LIME for

WATER PURIFICATION

CALCITE SUPERIOR — Lime Crest BRAND — HYDRATED LIME

What is said about it by users:

"Higher, Faster, pH reading";
"Longer Holding pH reading";
"Less sediment".
Its use assures easier, more certain control of alkalinity.

Experienced operators of water purification plants are finding this new hydrated lime a very exceptional product. We solicit an opportunity of submitting samples in sufficient quantity to demonstrate its qualities under your own working conditions. Material furnished without obligation.

LIMESTONE PRODUCTS CORPORATION of AMERICA

NEWTON • NEW JERSEY

CAN WE HELP YOU?

On other pages in this issue you will find described new and improved equipment, etc., as well as reviews of recent trade literature received by us. By requesting the literature described you will be able to keep your catalog file complete and up to date.

To our readers desiring additional help or information we will be glad to assist you in securing more complete information or data on any equipment or product you need. Use the convenient blank below—no cost or obligation.

WATER WORKS & SEWERAGE, 155 East 44th Street, New York, N. Y.

Gentlemen:—We are interested in the following items and would appreciate your assistance in securing more complete information:

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

NAME .....

ADDRESS .....

POSITION .....

February

AAC

"THERE ARE TWO WAYS TO SAVE MONEY ON COAGULATION"

FOR DETAILS WRITE

"The House of Coagulation"

ACTIVATED ALUM CORP.

OFFICE: 80 BROAD STREET NEW YORK, N. Y.

WORKS: CURTIS BAY BALTIMORE, MARYLAND

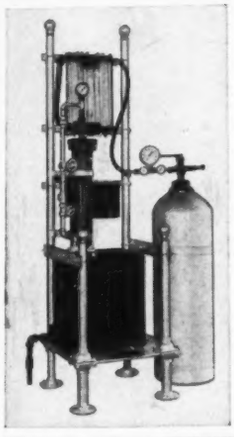
THE NATIONAL METHOD OF WATER MAIN CLEANING

30 YEARS EXPERIENCE

WRITE FOR OUR BOOKLET

NATIONAL WATER MAIN CLEANING CO.

50 CHURCH ST. NEW YORK



for Water and Sewerage Treatment

1 to 100 lbs. of Chlorine per day . . . $375.00 and up

EVERSON *Metered-Feed* **CHLORINATORS**

Here at last is a reasonably priced, accurate, chlorinator that anyone can operate safely. EVERSON Model G. Series Chlorinator offering for the first time: Any delivery from 1 to 100 lbs. of chlorine per 24 hours; Metered-feed; Intimate mixture of gas in water-sealed self-venting chamber; Protection against back-flooding by an automatic vacuum break, non-corrosion line and valves (Guaranteed against corrosion for 1 year) divided into standard replaceable units for safe, easy-cleaning and maintenance; Reliable equipment designed, manufactured and guaranteed by "The Swimming Pool People," specialists in water conditioning for two generations.

Write for Bulletin "C"

EVERSON MFG. CO.

633 W. Lake St., Chicago, U.S.A.

Use P F T Equipment in Your Sewage Treatment Plant

Write for Latest Bulletins

PACIFIC FLUSH TANK COMPANY

Designers & Manufacturers of Sewerage and Sewage Treatment Equipment

4241 Ravenswood Ave. Chicago, Ill.

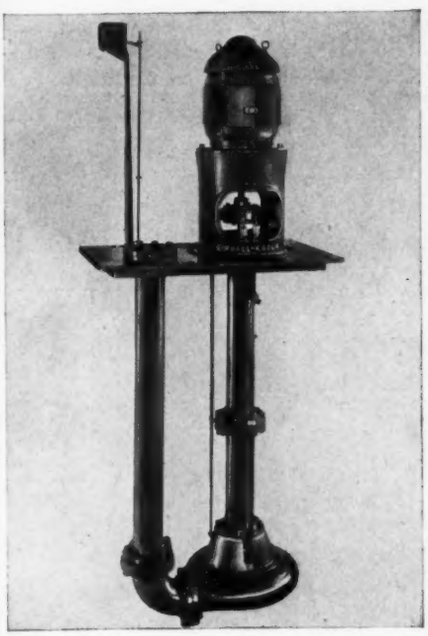
EXCLUSIVELY SINCE 1893

441 Lexington Ave. New York, N. Y.

A Worth-While Sewage Pump *Must* Be "Non-Clogging"

Unless a sewage pump is ACTUALLY "non-clogging" it cannot adequately meet YOUR requirements.

VICTOR-KIMBALL-KROGH Sewage Pumps meet your most rigid specifications.



1. Everything which passes into the pump—comes out.
2. The packing box is under vacuum — not pressure.
3. No "bleeder holes" to form ball-shaped obstructions.
4. Fully ball-bearing, of course.
5. Non-corrosive in service.
6. Heavy castings for longer wear.
7. Easily installed—economical to own and operate.
8. For horizontal or vertical positions.
9. For wet or dry pits.
10. Designed and built by a manufacturer with over 70 years of pump building experience.

You will want Bulletin No. 601 because it offers conclusive reasons WHY Victor-Kimball-Krogh "Non-Clogging" Sewage Pumps are outstandingly satisfactory. May we send you this comprehensive bulletin.

VICTOR EQUIPMENT COMPANY

KIMBALL-KROGH PUMP DIVISION

1010 E. 62d St. LOS ANGELES

VICTOR KIMBALL KROGH

515 Harrison St. SAN FRANCISCO

This man is pouring

SERVICISED

PIPE JOINTING COMPOUND

FOR BELL AND SPIGOT SEWER PIPE

It's a wise man who uses SERVICISED Pipe Jointing Compound for SERVICISED produces a joint that is tight, flexible, economical, absolutely waterproof, impervious to weather or soil conditions and prevents root growth or other infiltration problems.

Simple to heat and apply, SERVICISED Compound can be applied by odinary laborers. Further information on request.

© 1920

Asphalt Plank
Expansion Joint
Waterproofings
Asphalts
Fibre Plaster
Sheet Asphalt Waterproofing
For Sewer Tunnels

Write us about our SEWER PIPE BELT

SERVICISED PRODUCTS CORP.
6051 West 65th St. CHICAGO, ILL.

Arrowhead Grating & Treasd

Engineers' Handbook sent on request.

ARROWHEAD IRON WORKS, Inc.
431 W. 5th St., Kansas City, Mo.

Write for Illustrated Folder

"Jung Suction"
AERO-MIX
AERATOR - MIXER

"Aer-o-Mixing"

A *Distinctive* Process In Water and Sewage Treatment

VOGT MFG. CO., Inc. P. O. Box 1122, LOUISVILLE, KY.

EDSON'S NEW HAND PUMP

Smallest Diaphram Pump Made. 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

THE EDSON CORP'N, 49 "D" Street So. Boston, Mass.

NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 1064 Peoples Gas Building

Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

pH

MODERN pH and CHLORINE CONTROL

CHLORINE and PHOSPHATE CONTROL

A 54-page handbook containing a simple explanation of pH control and its practical application to numerous problems. The applications of chlorine are also discussed.

It also contains complete descriptions, with methods of operation, of our equipment for colorimetric pH, chlorine and phosphate control; also Coleman Glass Electrode.

Copy sent free on request.

W. A. TAYLOR & CO., INC.
872 Linden Ave. Baltimore, Md.

POSITIONS WANTED

This department has been started as a service to those in the Water Works and Sewerage Fields. We hope they will make use of it. The notices are inserted without charge.

STREET, SEWER AND WATER CASTINGS

Made of wear-resisting chilled iron in various styles, sizes and weights.

Write for Catalog and Prices

SOUTH BEND FOUNDRY CO.

Gray Iron and Semi-Steel Castings SOUTH BEND, INDIANA

ENGINEER—Licensed N. Y. and N. J., over 20 years' experience, municipal and construction; accustomed to managerial, supervisory and promotion work. Rated by former employers as resourceful, initiative, cooperative and dependable; has had repeat jobs. B. M., 1234 Taylor Ave., Bronx, N. Y.

SANITARY ENGINEER—Would like position as operator or chemist of water purification or sewage treatment plant or in design or research. I am a Jun. Am. Soc. C. E. with a B. S. from Yale in Civil Eng. and an M. S. from Harvard in San. Eng., 24 years old, single, Christian, and a hard worker. Have a good background of Sanitary Chemistry, bacteriology; design, and operation of sewerage systems, disposal plants, and water works. I can supply excellent references, and be available in a week's time. Address E. A. T., care Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

POSITION WANTED—As superintendent filtration, chemist and bacteriologist, or operator chemist and bacteriologist, of small or medium sized plant, by young man technically educated. Eleven years' experience. May I have the opportunity of attempting to fill your requirements. Address J. Z. C., Water Works & Sewerage, 400 W. Madison St., Chicago.

SUPERINTENDENT OF FILTRATION—By chemist in charge of large treatment plant with 10 years' experience. "E. L. B.," care Water Works and Sewerage, 155 East 44th St., New York City.

UTILITY ENG., 36 years old, married, 8 years' water works, 6 years' electric power and communications experience, in the Tropics, the Orient, and Northern U. S. Can handle men, mules, and machines. Now employed. Desires connection with a private Co., or consulting eng. Address K. T. V., care Water Works and Sewerage, 400 W. Madison St., Chicago.

SUPERINTENDENT Water Works. Age 45. 22 years' experience, construction and management. Will consider temporary work in drafting distribution system records for office and field, designing and constructing distribution system. W. A. G., care of Water Works & Sewerage, 155 East 44th St., New York City.

ROBERTS FILTERS

"STANDARD OF QUALITY"

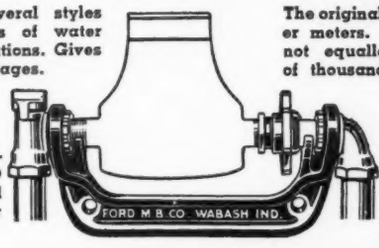
For more than thirty years we have specialized in the art of water purification. We manufacture a full line of water filters, both pressure and gravity type; Zeolite water softeners; swimming pool recirculating equipment; and various forms of water rectification units. Inquiries are invited on all problems of water treatment.

ROBERTS FILTER MANUFACTURING CO.
607 COLUMBIA AVE. DARBY, PA.

The FORD YOKE

Made in several styles for all types of water meter installations. Gives many advantages.

The original Yoke for water meters. Imitated but not equalled. Hundreds of thousands in service.



Write for catalog of FORD YOKES and other meter equipment.

Let us tell you what FORD yokes will do in your water works.

THE FORD METER BOX CO.
WABASH, INDIANA, U. S. A.

Water Control Equipment

You will be interested in the complete line offered by MUELLER. Write for catalogs of the equipment in which you are interested.

MUELLER CO. . . Decatur, Ill.

Factories: Decatur, Ill.; Chattanooga, Tenn.; Los Angeles, Calif.; Sarnia, Ont.

Branches: New York and San Francisco

Copperas...

(FERROUS SULPHATE)

... FOR WATER & SEWAGE TREATMENT

(The Base For Chlorinated Copperas)

We invite your inquiries

FAESY & BESTHOFF, INC.
22 E. 40th St. New York

GENERAL STEEL PLATE CONSTRUCTION

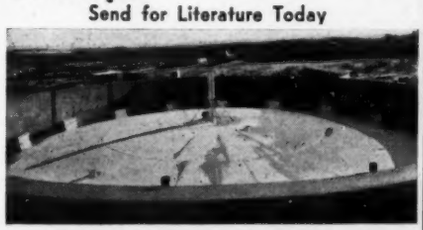
GRAVER TANKS

WATER CONDITIONING EQUIPMENT

Outstanding

The name GRAVER on any tank or metal structure is a mark of real quality. For three-quarters of a century the Graver Organization has served American municipalities through their expert designing, fabricating and erection service.

Send for Literature Today



CONSULT GRAVER WHEN IN NEED OF

Water Filters for mineral, taste, color and odor removal
Settlers
Chlorinators
Lime and Soda Softeners
Zeolite Softeners
Iron Removal Plants
Sterilizers

GRAVER TANK & MFG. CO., INC.
75 Years of Dependable Service
New York, N.Y. East Chicago, Ind. Chicago, Ill. Catasauqua, Pa.

SEND FOR YOUR COPY NOW

NEW • 256-page PUMP DATA BOOK

Here you have instantly, *all in one place,* useful information to solve practically any pump problem. Contains more than 150 pages of charts, curves, tables, prices, etc. It is written in simple, straightforward language, easily understood by anyone using pumps. It is a convenient, valuable and complete book for anyone interested in Pump Engineering.

• *Sent FREE upon receipt of coupon.*

ECONOMY PUMPING MACHINERY CO.
3433 W. 48TH PLACE
CHICAGO, U. S. A.

Attention: Kindly be sure to indicate Firm or Corporation and Position.

Name .....

Position..... Dept.....

Firm .....

Address .....

ADVERTISERS

The Dash (—) Denotes Current Advertisers Who Do Not Appear in This Issue.

A

Activated Alum Corp. 71
Albright & Friel, Inc. 68
Alvord, Burdick & Howson. 68
American Brass Co., The. 63
American Cast Iron Pipe Co. 16
American Hammered Piston Ring Div. of Koppers Co. 20-21
Anaconda Copper & Brass. 63
Arrowhead Iron Works. 72
Atlas Mineral Products Co. of Pa., The. 11

B

Barstow & Le Feber, Inc. 68
Bartlett Hayward Div. of Koppers Co. 20-21
Bellevue-Stratford Hotel —
Black & Veatch. 68
Bowen Research Corporation. 18
Builders Iron Foundry. 22
Burns & McDonnell Engr. Co. 68

C

*Carborundum Company, The. 17
Cast Iron Pipe Research Assoc., The. 24
Chain Belt Company. 10
Chester Engrs., The. 68
*Chicago Bridge & Iron Co. 8
Chicago Pump Company. 18
Chicago Rawhide Mfg. Co. —
Chicago Testing Laboratory, Inc. 68
Clark Controller Co., The. —
Columbia Alkali Corp., The. 9
Columbian Iron Works. 73
Cooper-Bessemer Corp. 7
Corning Glass Works. —
Crane Co. —

D

*Dorr Company, Inc., The. Third Cover
Dresser Mfg. Company, S. R. 65

E

*Economy Pumping Mach. Co. 73
*Edson Corporation, The. 72
Electro Bleaching Gas Co. —
Everson Mfg. Co. 71

F

Faesy & Besthoff, Inc. 73
*Filtration Equipment Corp. 19
Ford Meter Box Co. 73
Fuller & McClintock. 68
*Fuller Company 3

G

Gascoigne & Associates. 68
*Golden-Anderson Valve Specialty Co. —
Graver Tank & Mfg. Co., Inc. 73
Great Western Electro-Chemical Co. 66
Greeley & Hansen. 68
*Gruendler Crusher & Pulverizer Co. 70

H

Hellige, Inc. —
Hiler Engr. & Const. Co. 20-21
Hill Associates, Nicholas S. 68
Hills-McCanna Co. 59
Hudson Coal Co., The. 69

I

*Industrial Chemical Sales. 4
*Inertol Company, Inc. —
*International Filter Co. 16

K

Knowles, Inc., Morris. 68
Koppers Coal Co. 20-21
Koppers Company 20-21

L

La Motte Chemical Products Co. —
Layne & Bowler, Inc. 69
Limestone Products Corp. 70
Lock Joint Pipe Co. 70
Ludlow Valve Mfg. Co., The. 18
Lynchburg Foundry Company. 22

M

Maryland Drydock Co. 20-21
Mathieson Alkali Works, Inc., The. 14
Metcalf & Eddy. 68
Monsanto Chemical Company. —
Mueller Co. 73

N

*National Water Main Cleaning Co. 71
Nichols Engineering Research Corp. —
Norton Company 15
Nussbaumer & Clarke, Inc. 68

P

Pacific Flush Tank Co. 71
*Pennsylvania Salt Mfg. Co. —
*Permutit Company, The. 67
*Phipps & Bird, Inc. 70
Pirnie, Malcolm 68
Pittsburgh-Equitable Meter Co. Front Cover
Pittsburgh Steel Co. —
Portland Cement Asso. 12
Potter, Alexander 68
Proportioneers, Inc. 69

R

Reeves Pulley Company. —
Reilly Tar & Chemical Corp. 5
Riddick, Thomas M. 68
Roberts Filter Mfg. Co. 73
Royer Foundry & Machine Co. 13

S

*Servicised Products Corp. 72
*Simplex Valve & Meter Co. 16
South Bend Foundry Co. 72

T

Tar & Chemical Div. of Koppers Co. 20-21
*Taylor & Co., Inc., W. A. 72

U

*United States Pipe & Foundry Co. Second Cover

V

Victor Equipment Company. 71
*Vogt Mfg. Co., Inc. 72

W

*Wallace & Tiernan Co. Back Cover
Water Leak Detector Co. —
Western Gas Div. of Koppers Co. 20-21
White Tar Co. of N. J., Inc. 20-21
Whitman & Howard. 68
*Wood Co., R. D. 6
Wood Preserving Corp. 20-21

*Advertisers with * were represented in the May, 1936, Convention and Data Edition with catalog specification copy. Please refer to that issue for additional information on any of their products.

DORR MULTDIGESTION *at Battle Creek*

DORR MULTDIGESTION SYSTEM AT BATTLE CREEK

SHOWS

54.8% SOLID REDUCTION

65.7% VOLATILE REDUCTION

697 BTU PER CU. FT. OF GAS AND 65.5% METHANE

18 CU. FT. GAS PER POUND VOLATILE MATTER DIGESTED

Through the courtesy of N. G. Damoose, Engineer Manager of the Battle Creek, Mich. sewage treatment plant, we are giving below composite operating data on the Dorr Multdigestion System for the month of November, 1936. The Dorr Multdigestion System consists of a 45' x 25'-6" primary digester and a 60' x 22' secondary.

BATTLE CREEK, MICH. OPERATING DATA—NOVEMBER, 1936

Population	Contributing	40,000
	Equivalent Contributing (incl. ind. wastes)	68,800
Raw Sewage	Flow—M.G.D.	3.94
	Suspended Solids—Influent—P. P. M.	356
	Suspended Solids—Effluent—P. P. M.	104
	Suspended Solids—Removal—per cent	70.8
Raw Sludge	Volatile Solids—per cent	83.5
	Ash—per cent	16.5
Digested Sludge	Volatile Solids—per cent	63.4
	Ash—per cent	36.6
Reductions	Solid Matter—per cent	54.8
	Volatile Matter—per cent	65.7
Gas Production	Metered, exclusive wastage, cu. ft. per day	59,070
	Per capita per day (contrib. pop.)	1.475
	Per capita per day (equiv. pop.)	0.860
	Estimated, including wastage, cu. ft. per day	75,000
	Per capita, per day (contrib. pop.)	1.875
	Per capita, per day (equiv. pop.)	1.090
Gas Analysis	Heating value—B.T.U. per cu. ft.	697
	Methane content—per cent CH_4	65.5

The Dorr Multdigestion System consists of a heated and mechanically stirred primary tank and an unheated, plain secondary with an integral gas holder, supported by the gas. It assures a more completely digested sludge, greater gas production and a clearer supernatant. Today 29 installations are in use or on order, designed to serve a contributing population of 971,000 persons.

A note to our nearest office will bring further details and operating data.

DORRCO

Cities Using Dorr Multdigestion Systems

Atlanta, Ga.
Austin, Texas
Battle Creek, Mich.
Cedarhurst, L. I.
Colorado Springs, Colo.
Dixon, Ill.
Edwardsville, Ill.
Eldorado, Kans.
Elmhurst, Ill.
Fargo, N. D.
Fergus Falls, Minn.
Grand Forks, N. D.
Grand Island, Neb.
Hutchinson, Kans.
Iowa City, Iowa
Kokomo, Indiana
Lincoln, Illinois
Mansfield, Ohio
Monroe, Mich.
Natal, Brazil
Phoenix, Ariz.
Rahway Valley, N. J.
San Mateo, Cal.
Santa Clara, Cal.
Sheboygan, Wis.
Storm Lake, Iowa
Topeka, Kansas
Weyburn, Sask.
Yakima, Wash.

THE DORR COMPANY INC.

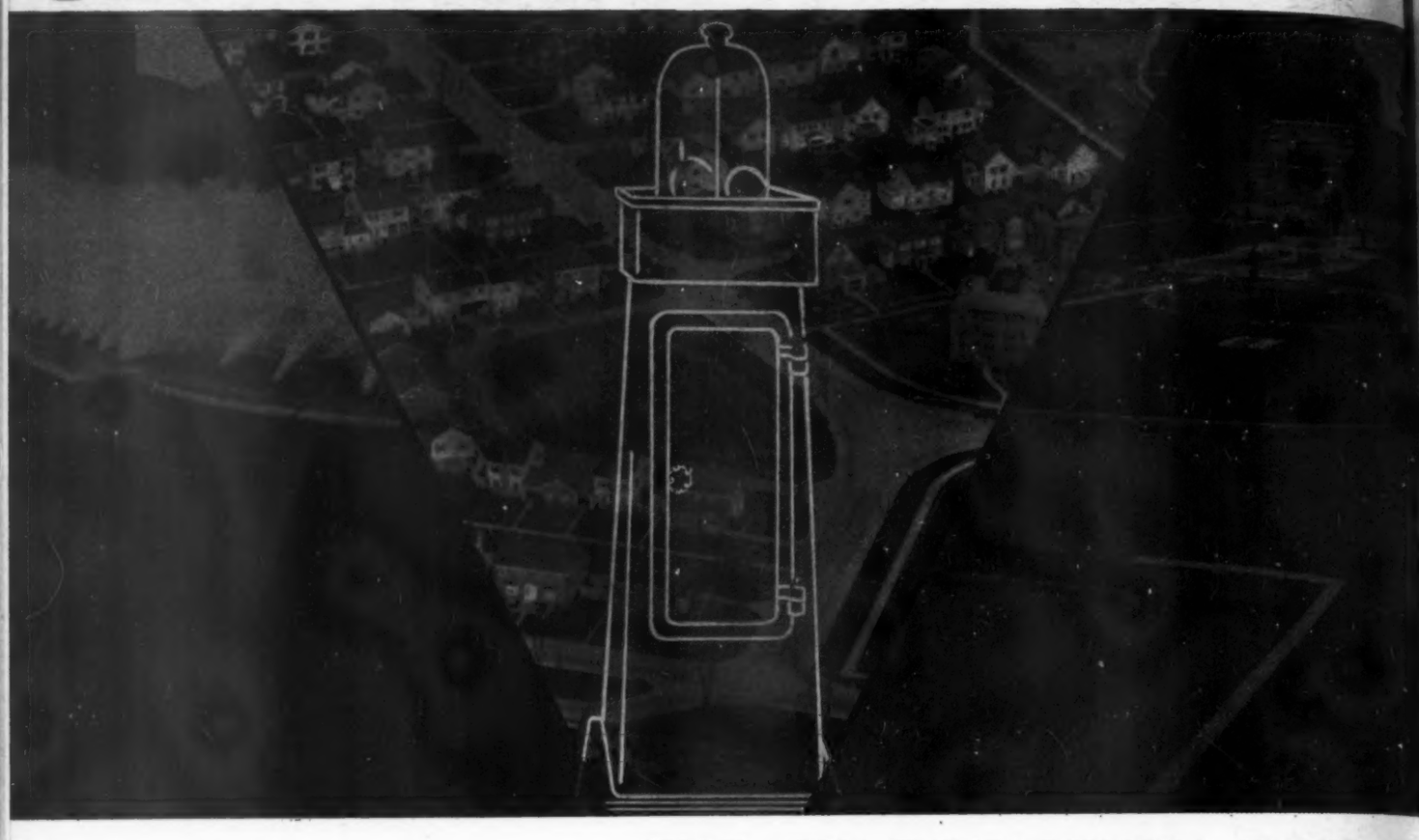
ENGINEERS • 570 Lexington Ave., New York

CHICAGO • TORONTO • DENVER • LOS ANGELES • ATLANTA

DORR TECHNICAL SERVICES AND EQUIPMENT ARE AVAILABLE FROM THE FOLLOWING COMPANIES:

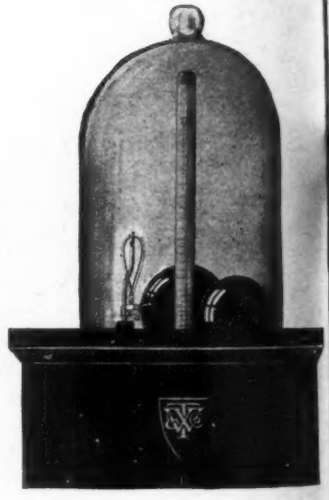
HOLLAND: Dorr-Oliver N. V. The Hague
FRANCE: Soc. Dorr-Oliver, Paris
GERMANY: Dorr Gesellschaft, m. b. H. Berlin
ENGLAND: Dorr-Oliver Company Ltd., London
AUSTRALIA: Crossle & Duffy Pty. Ltd., Melbourne
SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg
JAPAN: Andrews & George Co. Inc., Tokio
ARGENTINA: Luis Fiore, Buenos Aires
BRAZIL: Oscar Taves & Co., Rio de Janeiro

SAVING TOMORROW'S TAX DOLLAR



THE CHLORINATION DOLLAR

MUST BUY . . . DEPENDABILITY



NOT only for today but for tomorrow—for years of tomorrows—dependability is essential to chlorination. Protection of Public Health by the chlorination of water or sewage allows no halfway measures, no slipshod operation, no failure due to inadequate equipment.

With W&T Visible Vacuum Chlorinators, dependability is assured—together with accuracy, ease of control and reduced maintenance costs. An acknowledged leader for today, the W&T Visible Vacuum is also the Chlorinator of tomorrow—designed and built for years of accurate, unfailing, trouble-free service.

Tomorrow's taxpayers will thank you for today's choice of W&T Visible Vacuum Chlorinators.

Ask for technical publications 38, 157, 158

WALLACE & TIERNAN CO. Inc.

Manufacturers of Chlorine and Ammonia Control Apparatus

NEWARK, NEW JERSEY • BRANCHES IN PRINCIPAL CITIES

SA-46

THE ONLY SAFE WATER IS A STERILIZED WATER